FIFTEENTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

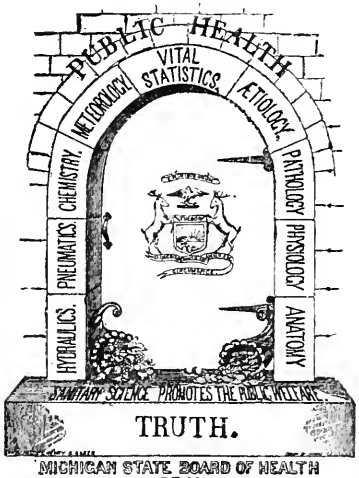
STATE BOARD OF HEALTH

OF THE

STATE OF MICHIGAN,

FOR THE

FISCAL YEAR ENDING JUNE 30, 1887.



MICHIGAN STATE BOARD OF HEALTH SEAL.

BY AUTHORITY.

LANSING, MICH.:
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1888.

Office of the Secretary of the State Board of Health,
LANSING, MICHIGAN, *January, 1888.*

To HON. CYRUS G. LUCE, *Governor of Michigan:*

SIR:—In compliance with the laws of this State, I present to you the accompanying Report for the fiscal year ending June 30, 1887.

Very Respectfully,

HENRY B. BAKER,
Secretary of the State Board of Health.

RESOLUTION OF THE BOARD RELATIVE TO PAPERS PUBLISHED IN ITS ANNUAL REPORT.

Resolved, That no papers shall be published in the Annual Report of this Board except such as are ordered or approved for purposes of such publication by a majority of the members of the Board; and that any such paper shall be published over the signature of the writer, who shall be entitled to the credit of its production as well as responsible for the statements of facts and opinions expressed therein.

CONTENTS.

REPORT

This is the Fifteenth Annual Report of the Secretary of the State Board of Health, and is for the fiscal year (nine months) ending June 30, 1887. (The report of property is for the year ending Sept. 30, 1887.) It is arranged and paged in two parts. The first contains the Secretary's report of work of the Board, the annual report of property, including accessions to the library, with names of donors. The second part contains eleven papers, abstracts and reports.

To this Report there is a supplement containing proceedings and addresses at the sanitary convention held at Big Rapids Nov. 18 and 19, 1886.

The papers are printed subject to a resolution of the Board, on page iv.

The names and postoffice addresses of the members of the Board, and the dates of the expiration of their terms of office, are as follows:—

VICTOR C. VAUGHAN, M. D., Ph. D., Ann Arbor, Jan. 31, 1889.

C. V. TYLER, M. D., Bay City, Jan. 31, 1889.

HENRY F. LYSTER, A. M., M. D., Detroit, Jan. 31, 1891.

JOHN H. KELLOGG, M. D., Battle Creek, Jan. 31, 1891.

JOHN AVERY, M. D., *President of the Board*, Greenville, Jan. 31, 1893.

ARTHUR HAZLEWOOD, M. D., Grand Rapids, Jan. 31, 1893.

HENRY B. BAKER, M. D., *Secretary of the Board*, Lansing.

The members of the State Board of Health, with the exception of the Secretary, are appointed for the term of six years, and receive no salary for their services.

STANDING COMMITTEES.

1. Epidemic, Endemic and Contagious Diseases.—H. F. Lyster, M. D.
2. Sewerage and Drainage.—H. F. Lyster, M. D.
3. Foods, Drinks, and Water-Supply.—V. C. Vaughan, M. D.
4. Buildings, including Ventilation, Heating, etc.—John Avery, M. D.
5. Climate, Geology, Topography, etc.—Henry B. Baker, M. D.
6. Disposal of Excreta.—John H. Kellogg, M. D.

7. Poisons, Explosives, etc.—V. C. Vaughan, M. D.
8. Occupations, Recreations and Habits.—J. H. Kellogg, M. D.
9. Relations of Schools to Health.—John Avery, M. D.
10. Sanitary Survey.—C. V. Tyler, M. D.
11. The Death-rate, as Influenced by Age.—Henry B. Baker, M. D.
12. Legislation.—C. V. Tyler, M. D.
13. Finances of the Board.—Arthur Hazlewood, M. D.
14. Mental Hygiene.—Arthur Hazlewood, M. D.
15. Diseases of Animals Dangerous to Man.—Henry B. Baker, M. D.
16. Relations of Preventable Sickness to Taxation.—J. H. Kellogg, M. D.
17. Plans for Model School Houses.—Hon. John Avery, M. D., J. H. Kellogg, M. D., and Arthur Hazlewood, M. D.
18. Alcoholic Liquors.—Henry F. Lyster, M. D., Victor C. Vaughan, M. D., and Arthur Hazlewood, M. D.

WORK IN THE OFFICE OF THE BOARD DURING THE FISCAL YEAR (NINE MONTHS) ENDING JUNE 30, 1887.

The work of the office naturally groups itself under three closely related heads,—the collection of information, the compilation and elaboration of information, and the dissemination of information. In the following outline that grouping has been made in part only in order to avoid repetition.

COLLECTION AND COMPILATION OF INFORMATION.

ANNUAL REPORTS BY HEALTH OFFICERS FOR THE YEAR ENDING DEC. 31, 1886.

In January, 1887, a circular (113) which had been approved by the Board, was sent to the health officer of each township, city and village in the State, about 1,454 in all, transmitting a blank form [I] for use in making his annual report to this office. This circular was substantially the same as circular 65 which is printed on pages viii-ix of the report for 1884. Blank form I, for reports of health officers, is printed in former reports. The circular (113) also transmitted a blank for a copy of the record of diseases dangerous to the public health, similar to the blank which is printed, reduced in size, on page 271 of the report for 1882.

ANNUAL REPORTS BY CLERKS OF LOCAL BOARDS OF HEALTH FOR THE YEAR ENDING DEC. 31, 1886.

At the same time (January, 1887) that the circulars and blank forms were sent to the health officers, a circular (112) asking for a report, and a blank form [J] on which to make a report, were sent to the clerk of the local board of health of each township, city and village in the State, about 1,454 in all.

A blank form for a copy of his record of cases of diseases dangerous to the public health was also sent; the circular and blank form sent to the clerk were similar to those sent to the health officer, except that they were not so explicit in questions relating to sickness and deaths.

WEEKLY REPORTS OF DISEASES IN 1886.

A list of observers of diseases for the calendar year 1886 is printed on pages 118–120. A compilation of reports, with a study of relations of sickness to climatic conditions, is printed on pages 105–169.

HEALTH BULLETINS.

The weekly reports of diseases received up to Wednesday of the week following the week for which they are made, are compiled on that day, week by week, and a bulletin, based on the compilation, is sent for publication to a large number of newspapers, and to sanitary and medical journals. A telegraphic abstract from the compilation is also sent weekly to a Michigan Press Association. A specimen of this weekly health bulletin can be found on page xii. of the Report for 1884. Beginning with the month of August, 1884, a monthly health bulletin has been issued immediately after the close of each month, for the use of monthly sanitary and medical journals, A specimen of the monthly bulletin can be found on page ix of the Report for 1885.

NAMES AND ADDRESSES OF HEALTH OFFICERS OF TOWNSHIPS, CITIES AND VILLAGES.

In April, 1887, the usual demand was made upon supervisors of townships, presidents and clerks of villages, and mayors and clerks of cities, for return of the names and postoffice addresses of health officers. The circular and blank forms used are similar to those printed on pages xiii–xiv of the Report for 1884. In June, 1887, a second demand was sent to localities from which no return had been made in response to the demand in April. In July, 1886, a list of the health officers and of their postoffice addresses was printed, when of the 1,488 townships, villages and cities in the State it was found that all but 230 localities were provided with health officers as the law requires. This number, during the following months of August, September and October, was considerably reduced. The number of townships, villages and cities that fail or refuse to comply with the law relative to the appointment of health officers, has on the whole diminished greatly since the organization of the Board, which denotes increasing vigilance in regard to public health. There is reason to believe that, in a few years, every locality in Michigan will constantly keep a health officer.

As fast as addresses of health officers for 1887 were received, a document detailing the duties of health officers was sent to each, together with blanks and copies of the documents on prevention and restriction of diphtheria, scarlet fever and typhoid fever.

METEOROLOGICAL REPORTS.

A list of meteorological observer for the calendar year 1886, with a statement of what registers were received from each, is printed on page 30. The reports are summarized in an article on the Principal Meteorological Conditions in Michigan in the year 1886, on pages 29–104. The data are of great value for purposes of studying the causes of diseases. The observations made at the office of the Board, at Lansing, have been summarized weekly, and a copy kept on file in the office.

SANITARY SURVEY OF CITIES AND VILLAGES.

The circular and blank planned for sanitary survey were sent in May, 1887, to mayors and health officers of all the cities in Michigan except a few of the largest, and to presidents and health officers of villages, also to about 200 newspapers in Michigan. Just how much has thus far been accomplished thereby is not known. The health officer of Petersburgh wrote in regard to the sanitary survey, that he could not hope to get a move in that direction at present, but would try and bring it about some time. The sanitary survey blank and circular induced the health authorities of Maple Rapids to publish a notice to the citizens to clean up. The health officer of Sheridan reported that he was doing something at a survey, but did not state what. The health officer of Flint placed the subject before the common council and spoke of its merits, but was unable to secure a survey. The city of Greenville ordered one thousand blanks. The city of Coldwater is believed to have had blanks printed, and Battle Creek conducted a sanitary survey. The circular and blank are as follows (reduced in size):—

MICHIGAN STATE BOARD OF HEALTH, OFFICE OF THE SECRETARY,
Lansing, Michigan, May 2, 1887.

DEAR SIR:—Believing that a careful house to house inspection, under the direction of the local board of health, would result in the discovery and removal of many sources of danger to the life and health of the citizens of your village, this State Board of Health has directed that a blank form for such sanitary survey be sent to you, and that I urge upon you the necessity and wisdom of making such a survey. The blank form is sent herewith.

Filth of any sort in houses or about premises is believed to be dangerous at all times, and especially dangerous during the warm months of summer and fall. Typhoid fever, a common disease in the villages of Michigan, is now believed to arise most frequently from the use of drinking water into which the contents of privies have leached through the soil—always more or less porous, and sometimes easily permeable for a long distance. Diphtheria and other diseases are also believed to be

favored by the presence of filth. So long as cholera remains in countries having close communication with our own, that supplies a strong reason for extreme care as to filth, and especially with reference to the water-supply.

For these and other reasons it is important to find out exactly what dangers to health are lurking unheeded in various parts of your village, and to remove and destroy the same as far as practicable.

A survey of this kind should be carefully and systematically prosecuted until the whole village has been examined. The expense of printing the necessary blanks, and of hiring suitable persons to make the examinations need not be very great, whereas the survey itself and its results would unquestionably prove of great benefit, *especially if the discovery of sources of danger is followed, as it should be, by their removal.* Indeed, the death, from a preventable cause, of but one public-spirited citizen would be an incalculably greater loss to any community than any sum expended in "cleaning up," or in other sanitary precautions. Nevertheless, in the villages of Michigan, the death of many such citizens is traceable every year to neglected privy vaults and other removable sources of danger.

A permanent record kept by the local board of health of the sanitary conditions of all premises in the corporation would be of great prospective value for study in future years, whenever sickness shall occur which should be investigated or restricted by the local board of health. Such records might well be consulted by persons wishing to buy premises.

Accurate reports to the State Board of Health, embodying facts which may be brought out by such surveys as are recommended by this board, would be valuable for use in studying the causes of certain diseases, their modes of spread, etc.

I trust that you and your village council will give this subject earnest attention, and will, if possible, inaugurate and carry out such a survey in your village.

This Board will be very glad to learn what you do, and to assist you in any way possible. If, at any time, you, or the person or persons whom your corporation employs to make the inspections, shall write to me in regard to any part of the work, I may be able to send suggestions or pamphlets bearing upon the subject.

By direction of the State Board of Health.

Very respectfully,

HENRY B. BAKER,
Secretary.

[S. B. of H., No. 118.] Inspection number.....

SANITARY SURVEY OF DWELLINGS AND PREMISES.

Village of....., County of....., Mich.
Premises of....., Street.....Street No.....
Examined.....188.., by.....
[Date.]

NOTE.—The sanitary condition of all markets, stores, schools, hotels, boarding-houses, shops, factories, railroad stations, etc., should receive careful attention; and such parts of this blank as are applicable, such, for instance, as those relative to the well, the privy, etc., may be used for that purpose; and the words "Dwelling House" may be changed accordingly.

DWELLING HOUSE.

1. About how many years built?.....
2. Well-preserved or decayed?.....
3. Built of wood, brick or stone?.....
4. Number of rooms in the house? - - - - - - - .....
5. Number of persons living in the house? - - - - - - .....
6. Number of inhabitants under ten years of age? - - - - - - .....
7. Is there over-crowding in sleeping rooms?.....
8. Does the house rest on a suitable foundation or upon the ground?.....
9. Is the soil upon which it is built wet, dry, low, or well-drained?.....
10. Is there a cellar under the house?.....
11. In what months of the year does water stand in the cellar?.....
12. Is the cellar clean and sweet, damp, mouldy, or foul?.....
13. Is the house too much shaded by trees or buildings?.....

OUTBUILDINGS.

1. How many outbuildings? - - - - - - - - - .....
2. Is there a barn?.....pig pen?.....privy?.....hen house?.....woodshed?.....
   and what other?.....
3. Distance from house to barn?.....feet.
4. Distance from house to pig pen?.....feet.
5. Distance from house to any other outbuildings?.....feet.
6. Is the sanitary condition of each of these buildings good or bad? Barn....., pig pen.....,
   privy....., hen house....., woodshed.....
7. Which are especially bad?.....

LOCATION AND SOIL.

1. Is the place situated on a hill, a side-hill, in a valley, or on level land?.....
2. Is the soil usually wet or dry?.....
3. Does the surface slope toward the well or away from it?.....
4. Is the surface composed of sand, gravel, loam, clay, rock, or made land?.....
5. What are the subsoil layers around the well and between it and the privy,—as indicated by
   the excavations?.....
6. Is the soil in the vicinity of the well (within six rods) contaminated by filth? If so, state the
   details.....
7. Is there any danger of filth passing into the well through the earth from privy, cess-pool, or
   other sources? If not, why not?.....

PRIVY.

1. Distance from the house?.....feet.
2. Distance from the well?.....feet.
3. Is there a vault under it?.....
4. What are the walls and bottom of the vault,—wood, stone, brick, or earth?.....
5. Is the vault water-tight?.....
6. How long has the vault been in use?.....years.
7. How often cleaned?.....
8. When last cleaned?.....
9. Is the vault now full or empty?.....
10. In what manner is the excreta cared for if there is no vault?.....
    .....
11. Is the privy clean, foul, or very foul?.....
12. Have the neighbors ever made any complaint?.....
13. What measures for improvement would you recommend?.....
    .....
14. Is there a water-closet on the premises?.....and if so, what is its condition.....
    .....
15. Is there an earth-closet on the premises?.....
16. If so, where is it placed?.....and what is its condition?.....
17. How many earth-covered or abandoned privy-vaults on the premises?.....

DRAIN AND CESS-POOL.

1. How near the well are slops thrown?.....feet.
2. Are they thrown on the ground or into some receptacle?.....
3. If thrown into a receptacle, what provision is there for carrying away the slops?.....
4. Is there any "hopper" for slops near the well?.....
5. How far is the cess-pool from the well?.....feet.
6. What is the sanitary condition of the cess-pool and of the soil in its vicinity?.....
7. Is there danger of slops draining, leaching, or filtering into the well?.....
8. What measures for greater safety would you suggest?.....

OTHER SOURCES OF FILTH IN AIR OR SOIL.

1. Is the general condition of the premises clean, unclean, or filthy?.....
2. Is there decaying garbage in the yard?.....
3. Is there decaying garbage in the cellar?.....
4. Any carrion on the premises?.....
5. Any dead animals buried on the premises?.....
6. Any other source of filth on the premises?.....

7. Any neighboring source of offense such as burial-ground, stables, cattle-yard, slaughter-house, sink-hole, marsh, mill-pond, etc?
8. What remedy would you advise?

WELL.

1. Kind—driven, bored, or dug?
2. Sides—of wood, stone, brick, tile, or iron pipe?
3. How covered over and protected from surface contamination?
4. Depth?.....feet.
5. Usual depth of water?.....feet.
6. Depth of water at time of observation?.....feet.
7. Does water drain into the well through its sides?
8. Distance to any privy?.....feet.
9. Distance to the receptacle for slops?.....feet.
10. Distance to the cess-pool?.....feet.
11. Distance to drain connecting slop receptacle with cess-pool?.....feet.
12. Any danger of slops getting into the well from leaky drain or cess-pool?
13. Distance to earth-covered vaults on the premises or adjoining?.....feet.
14. Distance to dung heaps?.....feet.
15. Distance to any other source of filth?.....feet from
16. Is the well water used habitually or only occasionally for drinking or cooking?
17. Is much or little water used?
18. Has any sickness been attributed to the use of the water?
19. When was the well last cleaned?
20. Has the water any color, taste or odor? If so, state its condition
21. What is the chief danger connected with the water-supply?
22. What measures would you suggest for the better protection of the drinking water?

CISTERN.

1. Where situated?
2. How is the cistern protected from the entrance of worms or small animals?
3. Is a wooden pump used in it?
4. Built of wood, brick, stone, or plastered on the earth?
5. How near to sources of filth?.....feet from
6. What is the nature of any leak? (The cistern may be cracked and leak only near the top. Of course if water FLOWS OUT through its sides when it is full, it may FLOW IN from the surface soil when the cistern is not full)
7. Is the water used for cooking or drinking?
8. If so, is it filtered before used?
9. If a filter is used, what form of filter is it, and how long has it been in use?
10. Has the water a sulphurous or offensive odor, or a foul taste?
11. Does it contain suspended matter, or small living creatures?

HEALTH OF OCCUPANTS.

1. Was there any sickness on the premises during the past year?
2. If so, from what diseases?
3. When did the sickness from each disease occur?
4. How long did it last?
5. How many cases of each disease were there?
6. How many deaths from each disease?
7. Is there any sickness in the family at present?
8. If so, what?
9. Has there been much sickness in past years?
10. From what diseases?
11. If from diphtheria, scarlet fever, small-pox, measles, typhoid fever, or other dangerous communicable disease, was disinfection performed? If so, how?
12. Do you think any of the cases of sickness which may have occurred, fairly attributable to infection from a previous case of illness? If so, please state particulars
13. If, in your opinion, there is any relation between the sickness mentioned and any unsanitary condition of the premises, what is it?

RECOMMENDATIONS.

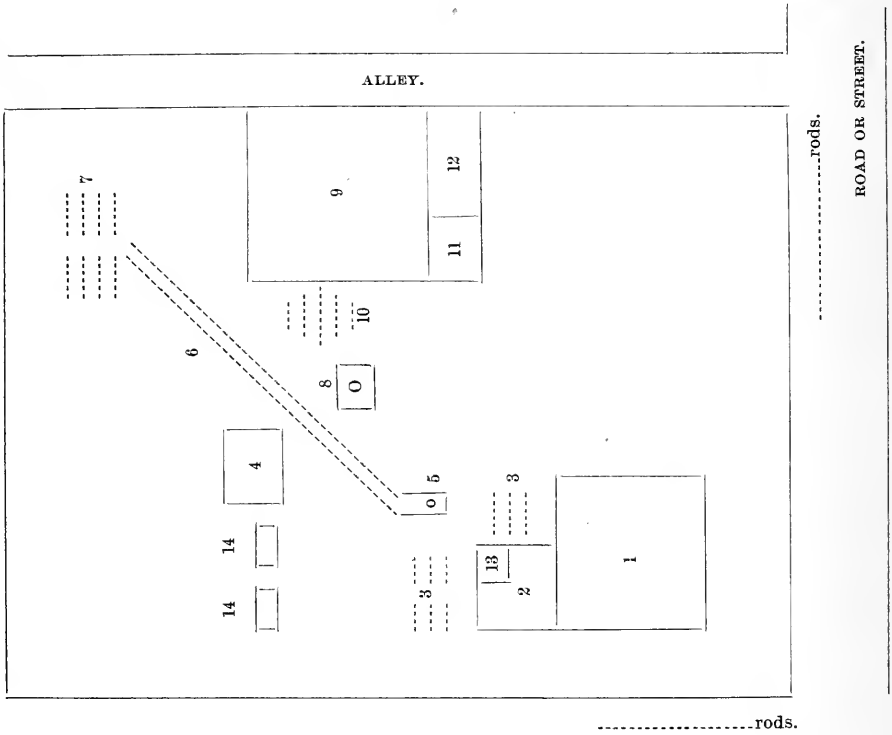
1. What measures would you advise for the sanitary improvement of the place?.....
2. About what will be the cost of the needed reforms? $.....
3. In your judgment what dangers will result from continued neglect?

The accompanying drawing is designed to indicate a method of showing the relative location of the house, well, privy, and other outbuildings in cases of more than usual interest. Such drawings greatly assist the understanding. They need not be drawn to scale, if it is inconvenient to do so but in every case all the distances should be accurately stated in the report in the blanks provided for that purpose. If on a sheet separate from this, the "Inspection Number" and name of premises may well be written upon it, to prevent confusion.

Inspection number.....

Premises of..... No..... .....Street,

Village of..... County of.....



1. House. 2. Shed. 3. Chip and house dirt. 4. Privy. 5. Slop receptacle. 6. Drain. 7. Cesspool. 8. Well. 9. Barn. 10. Dung-heap. 11. Hog pen. 12. Hen house. 13. Cistern. 14. Earth covered privy vaults.

SANITARY CONVENTION AT BIG RAPIDS, MICHIGAN.

A Sanitary Convention, under the auspices of the State Board of Health, was held in Big Rapids, Nov. 18 and 19, 1886. It was opened by an address of welcome by the mayor of the city, E. W. Hudnutt. Dr. John Avery, of Greenville, Mich., President of the State Board of Health, spoke in response to the address of welcome, and said that the object of the convention was not to benefit physicians, but the public. The members of the State Board

of Health also wished to gain information, that they may better serve the people. Rev. Henry Johnson, President of the Convention, read an able address.

Dr. John P. Stoddard, of Muskegon, read a paper on "Injuries of Every-day Drug-taking." He said the habit of taking drugs and nostrums was beyond comprehension. It partly came from mothers dosing babies with soothing syrup, hive syrup, paregoric, worm lozenges, etc. Druggists and proprietary medicine companies distributed flaming bills, chromos and free samples of nostrums from house to house. The prevention was to educate the people in the injurious effects of drugs. There should be less medicine taken, and only on the advice of a physician after a careful diagnosis. A doctor was not capable of prescribing for himself when ill, much less are the laity, who know nothing of the action of drugs.

Dr. David Inglis, of Detroit, read a paper entitled, "Alcohol: What Effect has it as Food, Medicine, or Poison?" In closing his remarks on alcohol as a medicine, he said: I should like to produce the continually accumulating evidence of the positive harm caused by such indiscriminate use of all kinds of alcoholic drinks, bitters and tonics. I should like, even more carefully, to define the conditions in which alcohol ought to be used than I have here done. I have only time to urge that we ought, in all cases, to let alcoholic liquors be the last, and not the first, remedy; that we ought to give alcohol in definite and known doses, and only during such time as the drug is required, and to make it our business to see that its use is then suspended, just as we do in case of opium.

Dr. J. L. Burkart, of Big Rapids, read a paper on "Water-supply of Big Rapids." The paper embodied the report of the committee appointed by the common council to investigate the matter of procuring a better article of water for that city, and contained much of special interest to the citizens of Big Rapids.

This was followed by a paper on "The Sanitary Needs of Big Rapids," by Dr. L. S. Griswold, which contained practical suggestions for the citizens of that city.

Prof. W. N. Ferris, of the Big Rapids Industrial School, read a paper on "Hygiene of Schools." He said that he could not recall ever having visited a room regularly occupied by 40 or 50 pupils, that could be said to be properly ventilated. Dullness, nervousness, headache, colds, catarrh and consumption are among the frequent effects of staying in such rooms. Under the influence of bad air study is irksome, good behavior difficult, and the play-ground a heaven. He dwelt upon the lack of ventilation in the Big Rapids schools; and said that the foul-air openings could be made several times larger with slight expense. Strange as it may seem, school patrons think very little about ventilation, and care less. Their sleeping and sitting rooms are without any intentional means of ventilation. Vitiated air is the most expensive commodity which man takes into his body; for in thousands of families the expenditure of money for a single year, which sickness and loss of time occasion by inhaling poison, would defray the necessary expenses for properly ventilating a decently constructed house. In several of the school-rooms of this city, the air space for each pupil does not exceed 200 cubic feet. We should construct rooms for lower grades very large, and use single desks. The speaker denounced the style of desks in use in one school-room in Big Rapids as "torture appliances."

Col. J. O. Hudnutt, C. E., of Big Rapids, read a paper on "A System of Sewerage and Drainage for Big Rapids."

Judge M. Brown, of Big Rapids, read a paper on "Public Health Laws." After referring to the health regulations of the ancients, he said: As civilization has advanced, and the average of mankind has reached a higher condition upon the plane of intelligence, health laws have become more general and better enforced. It may be stated as a fact that the race of man has advanced mentally and physically in porportion as heed has been given to the laws for the promotion of health. A kind of intuition seems to pervade the human race, aside from and above all law, that it is necessary to care for the public health in order to be comfortable and happy, and to enjoy this life. This intuition has probably led to the enactment of health laws by persons and bodies having legislative authority. * * * Some offenses against the public health are punishable by the common law—by fine and imprisonment—such as the selling of unwholesome provisions. When articles of food are sold for domestic purposes, the law implies a warranty that they are fit for such purposes. The Supreme Court of this State says that this rule is not only reasonable, but essential to public safety. He then discussed English sanitary work. He thought the laws of Michigan in regard to public health were good enough, but the way they are usually enforced is very bad. "Perhaps one of the greatest sources of sickness in our midst is the want of proper ventilation in buildings occupied as dwellings, public halls and other public places where large assemblages of people convene. In this county, until a very recent date, at every term of the circuit court more or less people in attendance became sick. Court was held in a room entirely unfit for occupancy on account of not being properly ventilated. * * * I desire to call attention to the subject of prisons and jails in this part of the State. I don't know a jail within the ninth congressional district that is properly ventilated, and hardly one that is proper for a human being to remain in over night. This subject has been agitated and investigated by the State Board of Health and the State Board of Corrections and Charities, and a great deal of valuable work has been done, but there is still very much to do."

Dr. Arthur Hazlewood, of Grand Rapids, a member of the State Board of Health, addressed the convention on the subject of "What to eat, When and How," and Dr. R. J. Kirkland, also of Grand Rapids, read a paper on "Care of the Eyes," both of which were interesting, but of which we have not been able to secure abstracts.

"Surface Filth as a Medium of Disease" was the subject of a paper by Rev. Henry A. Wales, of Big Rapids. He said: "In 1876 Dr. Henry Bowditch, of Boston, made an estimate of the annual cost to the people of the United States because of unnecessary sickness, and placed the figures at $100,000,000. Later, one of our own physicians—who is with us to-day—revised these estimates, going more into detail, and he increased the amount to $300,000,000,—a loss each year of over $10,000,000 to the people of Michigan. And this estimate leaves out of view the physical suffering, the mental pain and anguish, and the death of loved ones around our social circles." In regard to filth he said: "By surface filth we mean anything of this disgusting nature that is thrown upon or is suffered to lie upon the surface of the ground around our habitations or places of business—garbage, or the refuse of vegetable and animal matter; dirty water of every description, from that

in which food is cleansed to the dish-water and slops of a household; dirt swept from the floors of the home or shop; the contents of the wood-box and spittoons; the refuse of a wood-yard, hen-house or pig-pen; and the excrement from chambers and privies. Besides these, there are sources of filth in musty rooms, wool blankets, feather-beds, and the cellars under the house. Rubbish of any kind always becomes filthy if allowed to stand; and dampness increases filth by causing fermentation and vegetable growth. * * * A close inspection of all the premises of a habitation is continuously needed, that nothing which may cause filth shall be allowed to accumulate." Mr. Wales thought that the "grand march of the giant contagion begins in the surface filth and the vaults of the civilized privy;" and he thought that if the dry earth system were universally introduced, it would exterminate such diseases as cholera, dysentery, and typhoid fever, as they are propagated solely by germs in the voided excrement.

Prof. S. W. Baker, superintendent of Big Rapids public schools, discussed the paper by Prof. W. N. Ferris, on "School Hygiene," in which he dwelt largely on the subject of ventilation.

Prof. Henry F. Lyster, M. D., of Detroit, a member of the Michigan State Board of Health, read a paper for which no subject was announced. He said: "Nature cares absolutely nothing for individuals. It is the family, the species, the race that she cares for. When one of her laws has been contravened, it may not always be capital punishment, but it will always be punishment proportionate to the offense. She is implacable as long as the law is offended. She aks no reasons; she demands no explanations. She simply requires obedience. The more we study and understand her laws, the more clearly appears a Divine will governing them. An offense against the moral law of our nature brings its punishment in the deterioration of our moral nature just so long as it continues. * * * If you should go through the wards of St. Mary's or Harper's hospitals, you would see lying upon one of the beds a poor, wan consumptive, with a dash of too much brilliancy in his eyes, too long eye-lashes, too delicately a chiseled nose, too bright a crimson spot upon the cheeks, too hot and pungent a feeling to the long, thin hands. It may be from no fault or error of his own that he lies there. He is bearing the punishment to which nature, in her own unerring judgment, has set her seal. In this ward you might see a young man old before his time, whose uncertain, shuffling gait and feeble form have placed him, physically, among the octogenarians, and whose waning intellectual power and dull, sluggish brain fail to respond to any emotion of either joy or sorrow. Here is the victim of dissipation and intemperance. Nature is punishing him. The laws which he infringed years ago are unsatisfied. He has wrecked his own life, and who knows what other lives? He passed his Rubicon in early manhood. He will make his final ferryage before he should have reached the youth of his strengh. There is a beautiful little girl. Some deformity of the spine has been her lot. * * * She is suffering for the sins of her forefathers. Thus we see, on all sides, the victims of the infringement of natural laws. * * * While the genus and species will be preserved in nature, what can be done to save the individual and enable him to attain his highest degree of perfection, physically and mentally? It is here that a distinct science is applied, known as sanitary science. The discoveries in this science are nothing more than translation and application of natural laws to the preservation of health and the prolongation of life. * * * A young man is in no way

responsible for his inheritances, but sanitary science can teach him much that will profit him, and can do much to protect him. Suppose that his father had died at thirty of consumption, and that his mother at forty was in feeble health, very nervous and a victim of various neuralgias, and came from a comparatively short-lived family. Sanitary science would say to this young man, choose your occupation from among those which will enable you to be in the open air a large portion of the time; where exercise would insure good sleep at night; where 'good digestion waits on appetite, and health on both.' He should prefer the saddle to the office desk, the broad fields of the farm and the smell of the new-mown hay to the narrow streets and the lowering cloud of smoke and dust that hangs over the crowded city. He should turn his back upon the tempting offer of a clerkship in an insurance office, or store, and herd sheep in New Mexico, cattle in Montana, or manufacture pine lumber in Northern Michigan, or farm it in Washtenaw or Oakland county. Let him do anything under the sun rather than inure himself in the shadow of indoor life. Sanitary science comes to the aid of this young man in all of his environment. * * * The maintenance of parks and boulevards, public libraries, open-air concerts, an elevating press and free schools, are all powerful sanitary agents."

Dr. Jno. Avery, of Greenville, President of the State Board of Health, read a paper on the subject of "Pasteur and Protective Medicine." Dr. Avery told of Pasteur's parentage, his boyhood, his studies, and his first triumph as a chemist in discovering the left-handed polarizing tartaric acid. Pasteur, after this work, was made assistant professor of chemistry at Strasburg, where his first work was to prove the power of minute organisms to change or modify chemical affinity. He was then made dean of the faculty of science at Lille. Here he determined to devote a portion of his lectures to the study of fermentation. The prevailing theory of fermentation at this time, Pasteur could not accept. He experimented with milk, and discovered the lactic ferment. And soon after, in the same substance or some of its products, he found the butyric ferment. These two organisms he found to be entirely distinct. The lactic ferment required for its existence and multiplication, free oxygen or air; while the butyric ferment died when exposed to the atmosphere. Pasteur soon demonstrated that the special fermentation known as putrefaction is caused by a living organism belonging to the same class as the butyric ferment; and he also soon discovered the acetic acid ferment—the "*mycoderma aceti.*" Pasteur's next work was to demonstrate that spontaneous generation was a myth; and he then discovered the germ which caused so much havoc among the silk worms of France and other countries. He demonstrated that the disease among the silk worms was contagious, and gave practical directions for its prevention which restored the silk industry to Europe. This work led him to the great work of his life,—the development of the theory of the parasitic origin of communicable diseases; and in this effort he took up the disease known as anthrax or splenic fever which was decimating the flocks of all Europe. "He put a drop of splenic fever blood into sterilized yeast water; in a few hours it swarmed with myriads of bacteria. A drop of the first cultivation he put into a second flask containing the same kind of liquid and the bacteria multiplied as before. This process he repeated fifteen or twenty times, and by this means freed the initial drop of blood from any substance it might have carried with it. And now, if a drop of this last cultivation is injected under the skin of a rabbit or a

sheep, the animal dies with all the symptoms of idopathic splenic fever." Pasteur had studied vaccination, and he now undertook to vaccinate for protection of animals against splenic fever. "Before the close of the year 1881, Pasteur had vaccinated 33,946 animals. In 1882 the number amounted to 399,102, including 47,000 oxen and 2,000 horses. In 1883, 100,000 were added to the list. In 1881, it was the common practice of farmers to vaccinate one-half of their herds and leave the other half unprotected. It was found at the close of the year that the loss in the protected sheep was ten times less than in the unprotected, being one in 740 as against 1 in 78. In cows and oxen it was fourteen times less. * * * * In pursuing his investigations of the splenic fever disease, Pasteur made some curious and interesting discoveries which are of practical value to sanitarians and all who are interested in preventing the spread of communicable diseases. * * * He found that an attenuated virus that could cause no harm to a guinea pig of a year or a month or even a week old, would kill one just born. The weakened microbe could multiply itself in the blood of one so young; and a few drops of this pig's blood would kill one still older, and so on until the full virulence of the microbe was restored. * * * * Exposed to the air, these germs become weakened, or take on the form of spores, in which condition they will remain viable for years, and float in the air as minute particles of dust, until they find lodgment in the proper media for their development and multiplication. What is true of these germs may also be true of the germs of diphtheria, scarlet fever, small-pox, typhoid fever and other communicable diseases. In localities where these diseases have prevailed as epidemics, is it not quite possible their attenuated and viable germs are constantly floating in the air, ready to resume their active form whenever and wherever the conditions of climate, of poverty, of wretchedness, of filth, and of bad air present themselves?" Dr. Avery closed his paper with a discussion of Pasteur's work in inoculating for hydrophobia.

The last paper of the convention was on "Prevention of Communicable Diseases," by Dr. F. Gundrum, of Ionia.

Sets of the pamphlets issued by the State Board of Health, giving detailed methods for the restriction and prevention of each of the dangerous communicable diseases, were distributed in the audience.

LABORATORY OF HYGIENE.

The first quarterly report of the Michigan State Laboratory of Hygiene, by Prof. V. C. Vaughan, M.D., Ph. D., is printed on pages 1–23 of this report.

DANGERS IN GASOLINE.

A report on Dangers in Gasoline, by John H. Kellogg, M.D., is printed on pages 24–28 of this report.

SEWERAGE OF MARQUETTE.

On invitation of the Board of Sewer Commissioners, the Secretary of the Board visited Marquette to advise with them relative to the proper place as an outlet for their sewers. His report is printed on pages 170-173 of this report.

ANNUAL ADDRESS BY THE PRESIDENT OF THE BOARD.

At the regular meeting of the Board, held in January, 1887, Hon. John Avery, M.D., President of the Board, delivered his annual address. It is printed on pages 174-176 of this report.

TYROTOXICON.

A paper by Dr. V. C. Vaughan on this subject, read at the meeting of the Board in April, 1887, is printed on pages 177-185 ofthis report. This subject is continued by Dr. Vaughan in his first quarterly report of the laboratory of Hygiene, and is printed on pages 12–19 of this report.

INTERNATIONAL MEDICAL CONGRESS AT WASHINGTON.

The report of attendance at this Congress by Dr. Arthur Hazlewood is printed on pages 186-188 of this report.

The report of attendance at this Congress by Dr. V. C. Vaughan is printed on page 189 of this report.

NATIONAL CONFERENCE OF STATE BOARDS OF HEALTH.

The report of attendance at the National Conference of State Boards of Health, at Washington, by Dr. Henry B. Baker, is printed on pages 190–196 of this report.

THE CAUSATION OF COLD WEATHER DISEASES.

A paper on this subject by Henry B. Baker, M.D., is printed on pages 197–211 of this report.

DISSEMINATION OF INFORMATION.

Whenever information is received of the occurrence of diphtheria, scarlet fever, small-pox, or typhoid fever, copies of a document on the restriction and prevention of the disease reported are immediately sent to the health officer, with a request that he distribute them where they will be likely to be read. Copies of the documents on diphtheria, scarlet fever, and small-pox, in German or in Dutch, are also sent when it is thought they can be used to advantage. Owing to frequent requests for documents in French, Polish, Swedish, and Danish-Norwegian, translations of a leaflet on contagious diseases [47] have been made into each of these languages; and copies are sent to local boards when so requested.

A record is kept of reports received and of correspondence relative to each outbreak of a dangerous communicable disease of which the office receives information.

On receipt of the names and addresses of health officers, documents on restriction and prevention of diphtheria, of scarlet fever, of small-pox, and of typhoid fever, and on the work of health officers and local boards of health, are sent to each; and if each health officer would study these documents carefully, he could thereby acquire necessary information for the right performance of his duties.

The proceedings of sanitary conventions were printed and sent to localities where the conventions occurred. They were also sent to other parts of the State where it was thought that they would do good.

The proceedings of the meetings of the Board have been printed in pamphlet form and given to the press, and to persons likely to be interested.

EXAMINATION OF PLANS FOR PUBLIC BUILDINGS.

Although no plans for public buildings were submitted for examination during the fiscal year (nine months), ending June 30, 1887, penal, charitable, and reformatory institutions, supported by the State, are required by law (Sec. 7 of Act 206, laws of 1881) to submit plans for ventilation, sewerage, etc., of all proposed buildings, to the State Board of Health for expert advice or opinion. Someof these institutions have not complied, others, instead of submitting such plans to the Board of Health at its office, have required the State Board of Health to meet and see the plans at the institution controlled by those who are to submit the plans, and have even fixed the time when the meeting of the Board of Health must be held, and that on very short notice. At the meeting of the State Board of Health, held January 11, 1887, preambles and resolutions were adopted (printed on subsequent pages of this report) respectfully requesting officers of all penal, charitable and reformatory institutions to file such plans with the State Board of Health at Lansing, and to give such timely notice that a meeting may be called by the State Board of Health, or if possible that the plans may be examined at a regular meeting of the Board, and thus save the expense of a special meeting.

REPORT OF THE SECRETARY RELATIVE TO PROPERTY, ETC., FOR THE YEAR ENDING SEPTEMBER 30, 1887.

To the President and Members of the Michigan State Board of Health:

GENTLEMEN:—In compliance with Section 5 of Article II. of the by-laws of the Board, the following report of the "Nature and amount of property belonging to the Board, which has been received, issued, expended and destroyed since the last report, and of the property remaining on hand, and also in whose care each item of property is intrusted," is respectfully submitted:

My last report is printed on pages xii-xxxi of the Annual Report for the year 1886. Since that time instruments and articles of a similar nature have been purchased as follows:

Five photo-engraved plates, Diseases in Michigan in 1885.

One photo-engraved plate showing sickness in Michigan from pneumonia, and the average temperature, to illustrate Dr. Baker's paper on "Causation of Pneumonia."

One photo-engraved plate showing sickness in Michigan from pneumonia, and the average relative humidity, to illustrate Dr. Baker's paper on Causation of Pneumonia.

One photo-engraved plate, showing per cent of all deaths from diphtheria, to illustrate Dr. Baker's paper at Coldwater Sanitary Convention.

One photo-engraved plate showing per cent of all deaths from scarlet fever, to illustrate Dr. Baker's paper at Coldwater Sanitary Convention.

Two photo-engraved plates to illustrate Mr. Randall's paper at Coldwater Convention.

One photo-engraved plate exhibiting the relative position of a few of the wells and privy-vaults in Coldwater.

Two photo-engraved plates exhibiting deaths in Michigan from pneumonia, and average temperature, and average relative humidity.

Two photo-engraved plates exhibiting sickness in Michigan from pneumonia and average velocity of the wind, and ozone.

One photo-engraved plate showing sickness from pneumonia in U. S. armies and average temperature.

One photo-engraved plate showing deaths from pneumonia in London, and average temperature.

One photo-engraved plate, Deaths from Pneumonia in the U. S. armies, and average temperature.

One photo-engraved plate, exhibiting sickness from Bronchitis in Michigan, and average temperature.

Two photo-engraved plates exhibiting sickness from pneumonia, and average temperature, and average daily range of atmospheric pressure.

One photo-engraved plate, sickness from respiratory disease in 10,000 native troops, and the average temperature at six stations in India.

One basin for rainguage.

Two photo-engraved plates of map of Michigan, showing diphtheria and scarlet fever in Michigan in 1886.

Five photo-engraved plates, Diseases in Michigan in 1886.

One photo-engraved plate, diphtheria in Michigan in 1886, showing practical results in restricting.

Fifteen photo-engraved plates, Meteorological Conditions in Michigan in 1886.

Three photo-engraved plates: scarlet fever in Michigan in 1886, results of work with; sickness in Michigan from tonsilitis for a period of eight years, and average temperature, and sickness in Michigan from influenza for a period of ten years, and average temperature.

Meteorological instruments have been intrusted to observers as follows:

Psychrometer, set of registering thermometers, and raingauge to Frank E. Wood, Ripley, Portage Lake.

Barometer, psychrometer, set of registering thermometers, raingauge, and extra cup for psychrometer, to Prof. J. T. Ewing, Petoskey. The barometer, minimum thermometer, wet bulb thermometer and rain gauge at Petoskey were transferred by H. T. Caulkins, M.D., to Professor J. T. Ewing, February 5; the other instruments were sent from this office, February 7.

The psychrometer, set of registering thermometers and raingauge at Bay Port were transferred by W. B. Rosevear to J. B. Grant without coming to this office.

The barometer, psychrometer, registering thermometers, and raingauge at Tecumseh were transferred by L. G. North, M.D., to M. P. Brown without coming to this office.

Meteorological instruments, etc., remaining in the office of the Board, September 30, 1887:

One standard thermometer.

Four sets of registering thermometers, complete.

Two minimum thermometers.

Nine psychrometers, complete.

One psychrometer cup.

Four dry bulb thermometers.

Three wet bulb thermometers.

Three registering thermometer boards.

Five registering thermometer clips.

Two psychrometer clips.

Four standard barometers.

Six barometer boxes.

Four raingauges with overflow tubes.

One basin to raingauge.

One raingauge.

Three caps to overflow tubes to raingauges.

Three measuring sticks to raingauges.

Five screw bolts and five pins to register thermometer boards.

One worn out anemometer spindle.

Three anemometer cups, rusted and spoiled by long exposure.

Two thermometers broken accidentally and returned by observers.

Books and other publications have been received and placed in the library of the Board (during the year ending Sept. 30, 1887) as follows:

BY PURCHASE.

The Influence of the Sympathetic on Disease.—E. Long Fox, M. D.

The Journal of Physiology, Vol. VII, No. 1.

Handbuch der Historisch-Geographischen Pathologie von Dr. August Hirsch.—Hirsch.

A Text-Book of Physiology. Third American. From the Fourth and Revised English Edition.—Foster.

United States Official Postal Guide, Jan. 1887.

Whirlwinds, Cyclones and Tornadoes.—Davis.

The Methods of Bacteriological Investigation.—Hueppe. Translation by Hermann M. Biggs.

Encyclopedia Britannica, Ninth Ed., Vol. XXI, Vol. XXII.

Twenty-Five Years with the Insane.—Putnam.

Diseases of Tropical Climates.—Maclean.

Recent Essays by various authors on Bacteria in Relation to Disease.—Cheyne.

New Sydenham Society's Lexicon of Medicine and Allied Sciences.—Power and Sedgwick.

Hirsch's Handbook of Geographical and Historical Pathology. New Sydenham Soc. Vol 117.

Report of Com. appointed by the Lords Commissioners of the Admiralty on causes of recent Outbreak of Scurvy in Arctic Expedition.

Vorlesungen über Specielle Pathologie und Therapie.—von Dr. C. Liebermeister, Dritter Band.

A Treatise on Diphtheria, historically and practically considered.—Sanné, Trans. by H. Z. Gill.

The Cremation of the Dead.—Erichsen.

Notes embodying Recent Practice in the Sanitary Drainage of Buildings, with Memoranda on the Cost of Plumbing Work.—Gerhard.

Transactions of the National Association for the Promotion of Social Science, 1861.

VI Internationaler Congress für Hygiene und Demographie zur Wien, 1887, Heft Nr. 1, Nr. 2. Nr. 3, Nr. 4, Nr. 5, Nr. 7, Nr. 8, Nr. 9, Nr. 10, Nr. 12, Nr. 13, Nr. 14, Nr. 15, Nr. 16, Nr. 17, Nr. 19, Nr. 20, Nr. 21, Nr. 23, Nr. 25.

Official Postal Guide.

Scientific American and Supplement.

Sanitary Engineer, New York.

American Meteorological Journal, Ann Arbor.

American Journal of Medical Sciences.

American Lancet, Detroit.

Popular Science Monthly.

Lancet, London.

Nature, London.

British Medical Journal, London.

Practitioner, London.

Sanitary Record, London.

Science, New York.

Comptes Rendus Hebdomadaire des Seances de l'Academie des Sciences, Paris.

Revue de Hygiene, Paris.

Sanitary Journal, Glasgow, Scotland.

Archiv für Hygiene, Munich.

Centralblatt für Allgemeine Gesundheitspflege.

Berliner Klinische Wochenschrift.

Received in Exchange for Publications of this Board, the following periodicals (in some instances incomplete volumes):—

Alabama Weather Service.

American Analyst, New York.

American Exchange and Review, Philadelphia.

American Monthly Microscopical Journal, New York.

American Pharmacist, Detroit.

American Practitioner and News, Louisville.

Annals of Hygiene, Philadelphia.

Anti-Adulteration Journal.

Babyhood, New York.

Buffalo Medical and Surgical Journal.

Boletin Mensuel, Spain.

Building, New York.

Bulletin de l'Academie Royale de Medicine de Belgique.

Bulletin Hebdomadaire de Statistique Demographie et Medicale, Havre.

Bulletin de la Societe des Creches.

Bulletin Mensuel du Bureau de Demographie, Marseilles.

Bulletin, New England Meteorological Society.

Bulletin of North Carolina Board of Health.

Calcutta Health Officer's Quarterly Report.

Canada Lancet, Toronto.

Canada Medical and Surgical Journal.

Canadian Practitioner, Toronto.

Chicago Medical Journal and Examiner.

Cincinnati Lancet and Clinic.

College and Clinical Record, Philadelphia.

Columbus Medical Journal, Columbus, Ohio.

Crop Prospects, Illinois.
Daniels Medical Journal, Austin, Texas.
Druggists' Circular, New York.
Ephemeris, Squibbs, Brooklyn, New York.
Good Health, Battle Creek.
Herald of Health, New York.
Hygiene Practique, Paris.
Indicator, Detroit.
Italian Meteorological Society Monthly Bulletin.
Journal of American Medical Association, Chicago.
Journal D' Hygiene, Paris.
Journal of Franklin Institute.
Leonard's Illus. Medical Journal.
Manufacturer and Builder, New York.
Maryland Medical Journal.
Medical Age, Detroit.
Medical Bulletin, Philadelphia.
Medical Counselor, Detroit.
Medical News, Philadelphia.
Metal Worker, New York.
Manadsofversigt af Vaderleken i Sverige.
Michigan Crop Report.
Missouri Weather Service.
Minnesota State Weather Service and Crop Report.
Mississippi Valley Medical Monthly.
Modern Crematist, Lancaster, Pa.
Monatshefte zur Statistik des Deutschen Reichs.
Monthly Bulletin of the Iowa State Board of Health.
National Druggist, St. Louis.
Nashville Journal of Medicine and Surgery.
New York Medical Abstract.
New York Medical Journal.
North Carolina Medical Journal, Wilmington.
Northwestern Lancet, St. Paul, Minn.
Ohio Meteorological Bureau.
Philadelphia Medical Times.
Physician and Surgeon, Ann Arbor.
Pharmaceutical Era, Detroit.
Public Health in Minnesota.
Quarterly Journal of Royal Meteorological Society.
Quarterly Return of Marriages, Births and Deaths in Ireland.
Sanitary Era, New York.
Sanitary News, Chicago.
St. Louis Medical Journal.
Salford Health Bulletin.
Swiss Cross.
Therapeutic Gazette, Philadelphia.
Tablettes Mensuelles, Belgique.
Tennessee Crop Report and Weather Service.
Tennessee State Board of Health Bulletin.
Vaccination Inquirer, London.
Veröffentlichungen des Kaiserlich, Deutschen Gesund.
Veröffentlich. des Statistischen Amts der Stadt Berlin.
Weather Review, Monthly, Washington.
Weekly Medical Review, Chicago.
Weekly Returns of Births and Deaths in Dublin.

By Gift, Exchange, etc. (*Names and Addresses of donors being printed in Italics*):—

Abbott, M. D., S. W., Boston, Mass:—
44th Report to the Legislature of Mass., relating to the Registry and Return of Births, Marriages and Deaths for the Year ending Dec. 31, 1885.
18th Ann. Rep. of Mass. Board of Health.
Manual for the use of the Mass. Boards of Health.
7th Ann. Rep. of the Mass. State B'd of Health, Lunacy and Charity.

Allen, M. D., C. L., Montpelier, Vt.:—
Duties of Selectmen in regard to Preservation of Public Health.
Sanitary School Houses, Circ. No. 3.
Act to establish Local B'ds of Health.
Questions concerning Topography, Diseases, etc., Circ. No. 2.

Allen, M. D., Nathan, Lowell, Mass.:—
Physical Culture in Amherest College, Oct. 12, 1886.
Ann. Rep. of Lowell B'd of Health, 1886.

Alton, M. D., C. D., Hartford, Conn.:—
The Medical Adviser in Life Assurance.
Practical Miscellany, No. 1. Diet in Relation to Age and Activity.
Mortality Experience of Conn. Mutual Life Ins. Co., 1846-1878.

Ashmun, M. D., G. C., Cleveland, O.:—
14th Ann. Rep. of Health Dep't of Cleveland, 1886.

Baker, M. D., Henry B., Lansing, Mich.:—
Boston Med. and Surg. Jour., May 27, 1886.
Proposed Laboratory of Hygiene at Mich. University.
Rep. of Special Com. of Am. Pub. Health Ass'n on Disinfection of Rags.
Some of the Cold-Weather Communicable Diseases.

Baird, Prof. Spencer F., Washington, D. C.:—
Ann. Rep. B'd of Regents, Smithsonian Inst'n, 1884, Part II.
Ann. Rep. Smithsonian Ins. B'd of Regents, July, 1885, Part I.

Balch, M. D., Lewis, Albany, N. Y.:—
Circular issued by N. Y. B'd of Health concerning Burial Permits.

Ballot, Buys, Utrecht, Netherlands:—
Nederlandsch Meteorologisch Jaarboek, 1878.
Nederlandsch, Meteorologisch Jaarboek, 1886.

Barwick, James A., Sacramento, Cal.:—
Ann. Meteorological Review of California, 1886.

Becker, Dr. K., Berlin, Germany:—

Statistiches Jahrbuch für das Deutsche Reich, 1886.

Bell, M. D., A. N., Brooklyn, N. Y.:—

Abstract from Trans. of N. Y. State Med. Soc., 1887, Prize Essay.

Betton, Frank H., Topeka, Kansas:—

1st Ann. Rep. of Ks. Bureau of Labor and Ind'l Statis., 1885, 2nd, 1886.

Biddle, Cadwalader, Harrisburgh, Pa.:—

16th Ann. Rep. of Penn. B'd of Com'rs of Public Charities.

Bidenkap, Dr., Christiana, Norway:—

Beretning om Folkemaengden og Sundhedstilstanden i Christiana, 1885.

Bishop, James, Trenton, N. J.:—

6th, 7th and 8th Ann. Rep'ts, N. J. Bureau Labor Statistics, 1883, '84, '85.

Board of Charities, Minn. State, St. Paul, Minn.:—

1st Bien. Rep. Minn. B'd Corrections and Charities, 1884.

2nd Bien. Rep. of same. Period ending July 31, 1886.

Board of Education, Mich. State, Lansing, Mich:—

3d Biennial Rep. of Mich. Board of Education, two years ending Sept. 30, 1886.

Board of Health, Mich. State, Lansing, Mich:—

Report of Proceedings Mich. Board of Health, Oct. 1, 1886. [No. 111.]

13th Annual Report of the Sec. of the State Board of Health of Mich., for the fiscal year ending Sept. 30, 1885.

Consumption. Its Causes and Prevention. [Reprint No. 253.]

Prevention of Cholera Infantum and kindred diseases, and of Poisoning by Cheese, Milk, etc. —Vaughan.

The above circular improved.

Abstract of Proceedings, Regular Meeting, July, 1887. [122.]

Prevention of typhoid fever. [124.]

Public Health Laws, by Judge M. Brown. [Reprint No. 258.]

Sanitary Progress in Michigan: An Address before the Reunion of the Michigan Legislative Association, June 11, 1886, by Senator James Hueston, M. D.

Principal Meteorological Conditions in Michigan, 1885. [Reprint No. 192.]

Time of Greatest Prevalence of Each Disease in Michigan, 1885. [Reprint No. 193.]

Abstract of Proceedings of Michigan Board of Health, January 11, 1887. [No. 114.]

Series of 8 Diagrams showing relation of Pneumonia, etc., to Meteorological Conditions.

National Conference of State Boards of Health, Toronto, Ont., October, 1886. [Reprint No. 194.]

Proceedings and Addresses at Sanitary Convention, Coldwater, Michigan, September, 1886. [Reprint No. 255.]

President's Address, Hon. N. P. Loveridge, Coldwater Convention, September, 1886.

Prevention and Restriction of Communicable Diseases. [Reprint No. 252.]

Alcohol; Its effects as a Food, as a Medicine, and as a Poison. [Reprint No. 256.]

Proceedings and Addresses at Sanitary Convention, Big Rapids, Michigan, November, 1886.

M. Pasteur, and Protective Medicine. John Avery. [Reprint No. 259.]

Work of Health Officers and Local Boards of Health in Michigan. [120.]

Personal Duties and Responsibilities of the People for the Preservation of the Public Health. [Reprint No. 254.]

Böckh, Richard, Berlin, Germany:

Stat. Jahrbuch der Stadt, Berlin, 1884.

Böens, Hubert, Charleroi, Belgium:

Conference de Paris, 25 Juillet, 1886.

Böhmert, Dr. Victor, Dresden, Saxony:

Kalender und Statistisches Jahrbuch für das Königreich Sachsen. 1887.

Zeitschrift des K. Sächsischen Statistischen Bureaus, 1885, Heft III. und IV.

Zur Mathematischen Statistik, von Dr. Gustav Zenner.

Zeitschrift des K. Sächsischen Stat. Bureaus, Sup. Zum XXXII., 1886.

Booker, F., Coventry, Eng.:

12th Ann. Rep. of Med. Officer of Health of Coventry Urban Sanitary District, 1886.

Boyd, M.D., S.B, Knoxville, Tenn.:

13th Ann. Rep. Knoxville Board of Health, 1886.

Browne, M.D., John S., New York City:

Intubation of Larynx, papers read before the New York Acad. of Med., June, 1887.

Physical Examination of Weak Chests.

Browne, E. L., Brockton, Mass.:

Board of Health Regulations of City of Brockton:

Report of City Engineer, also Rep. on Disposal of Sewage.

Abstract of Census of Mass., 1860. From the 8th U. S. Census.

Abstract of Census of Mass., 1865, and supplementary tables.

Report of Committee on Sewerage.

Report of Committee on Water-Supply for Brockton.

Report of a Commission appointed to consider a general system of drainage for Valleys of Mystic, Blackstone, and Charles Rivers, Mass.

Rep. of City Engineer on Disposition and Treatment of Manufacturing Wastes.

Separate vs. the Combined System of Sewerage.
Rep. on System of Sewerage for Binghampton, N. Y.
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2d Ann. Rep. of Newark B'd of Health, 1886.

Watanabe, H., Tokio, Japan;—
Imp. University of Jap., Calendar for 1886-'87.

Watson, M. D., Irving A., Concord, N. H.:—
Rep. of Com. on Disinfectants, Toronto, Oct. 1886.

Whitelegge, M. D., B. A., Nottingham, Eng.:—
Rep. of Med. Officer of Borough of Nottingham, 1886.
Ann. Health Rep. of Borough of Nottingham, 1885.

Whipple, G. M., Richmond, Surrey, Eng.:—
The Kew Observatory, Rep. for y'r ending Oct. 31, 1886.

Wiley, Dr. H. W., Washington, D. C.:—
Foods and Food Adulterants, Part 1st, Dairy Products.

Wolf, Dr. T. R., Newark, Del.:—
Rep. of Delaware State Chemist, 1886.

Wood, M. D., Thomas F., Wilmington, N. C.:—
Bienn, Rep. of N. C. B'd of Health, 1887.
N. C. Weather Service, Special Instructions for Voluntary Observers.

Wright, Carroll D., Washington, D. C:—
Second Ann. Rep. of Com'r of Labor, 1886, Convict Labor.

Young, M. D., A. G., Augusta, Maine;—
Act to Establish Local Boards of Health in Maine, Contagious and Parasitic Diseases of Animals.
Second Ann. Rep. of Maine B'd of Health, 1886.

Young, William, London, England;—
Some Leading Arguments against Compulsory Vaccination.
Notes on Small Pox and Vaccination in India.

WEEKLY OR MONTHLY MORTALITY STATEMENTS.

These have been received during the past year from health officers, registrars, officers of Boards of Health, or of cities in the United States or foreign countries, as follows:

Abbott, M. D., S. W., Health Officer, Dep't of Health, State House, Boston, Mass.
Allen, Nathan, Chairman Board of Health, Lowell, Mass.
Ashmun, M. D., G. C.. Health Officer, Cleveland, Ohio.
Balch, M. D., Lewis, Sec. State Board of Health, Albany, N. Y.
Baldwin, Cyrus W., Registrar, Paterson, N. J.
Bidenkap, Dr., Chef del Administration Sanitaire, Christiana, Norway.
Boyd, Geo., Registrar Vital Statistics, Paterson, N. J.
Boyd, M. D., S, D., Secretary Board of Health, Knoxville, Tenn.
Briggs, M. D., Albert H., Health Physician and Registrar of Vital Statistics, Buffalo, N. Y.
Bryce, M. D., P. H., Secretary Provincial Board of Health, Toronto, Ont.
Buck, M. D., E. W., Health Officer and City Physician, Oakland, Cal.
Bureau d' Hygiene, Havre, France.
Bureau de Demographie et de la Statistique Medical de la Ville, Marseilles, France.
Burke, M. D., J. J. A., Health Officer, Rochester, N. Y.
Carson, M. D., Gib. W., Clerk of Health Commissioner and Board of Health, St. Louis, Mo.
Carter, A. Robert, Secretary City Board of Health, Baltimore, Md.
Cargill, H. N., Clerk of Board of Health, Grand Rapids, Mich.
Cocchi, A., Il Direttore, Dell'Officio di Statistica e Stato Della citer di Roma, Rome, Italy.
Day, M. D., Walter DeF., Sanitary Supt. and Registrar, N. Y. City.
Det. Kgi. Sundheds Collegium, Copenhagen, Denmark.
DeWolf, M. D., O. C., Health Officer, and Tomlinson, A. M., M. D., Registrar of Vital Statistics, Chicago, Ill.
Fuchs, Dr. J. M., Secretaris Commissie van toezicht op den Stedelyken Geneeskundigen Dienst, Amsterdam, Netherlands.
Grimshaw, M.D., Thomas W., Registrar-General, Dublin, Ireland.
Hamilton, John B., Supervising Surgeon-Gen. Marine Hosp. Service, Washington, D. C.
Horlbeck, M.D., H. B., City Registrar, Charleston, S.C.
Holt, M.D., Joseph, President of State Board of Health, New Orleans, La.
Johns, James, City Sexton, Lansing, Mich.
Laberge, M.D., L., Medecin de la Citè, Montreal, P.Q.
Lee, Wm. H., Registrar, Wilmington, Del.
Lindsley, M. D., C. A., Health Officer, New Haven, Conn.
Linsley, M.D., J. H., Health Officer, Burlington, Vt.
Martin, M.D., R. Commissioner of Health, Milwaukee, Wis.
Mitchell, M.D., Charles, Health Officer and Registrar, Nashville, Tenn.
Ottersen, M.D., A., Com'r of Health, Brooklyn, N.Y.
Ridick, M.D., James G., Health Officer, Norfolk, Va.
Robinson, M.D., D.E., Health Officer, Manistee, Mich.
Scales, M.D., T. S., Health Officer, Mobile, Ala.
Snively, M.D., W., Registrar, Pittsburg, Pa.
Snow, Edwin M., Sup't of Health, Providence, R.I.
Stanton, M.D., Byron, Health Officer, Cincinnati, O.
Statistisches Amt der Stadt Berlin, Berlin, Germany.
Stratton, M.D., T. E., Pres. Board of Health, Richmond, Va.
Tatham, M.D., John, Medical Officer of Health, Salford, Eng.
Townshend, M.D., Smith, Health Officer and Registrar, Washington, D.C.
Tyrrell, M.D., G. G., Sec. State Board of Health, California.
Van Pelt, C. L., Health Officer, Toledo, O.
Wallace, M.D., David L., Sec. B'd of Health, Newark, N. J.
Wheeler, M.D., John B., Health Officer, Burlington, Vt.
Wight, M.D., O. W., Health Officer, Detroit, Mich.
Williamson, M.D., Secretary Board of Health, Memphis, Tenn.

Excepting certain publications drawn out by members of the board and others, the foregoing, together with those accounted for at date of the last annual report as in the library, or drawn out, are in the library and in good condition. Those drawn out, and not yet returned, are as follows:

BY HOMER O. HITCHCOCK, M. D.

Memoirs on Diphtheria, Library No. 716.
Prevention of Cholera Infantum and Kindred Disorders, No. 1528.

BY HON. LEROY PARKER.

An ordnance relative to the appointment and duties of the City Physician of West Bay City, No. 1760.
Sanitary Chart on Management of Infants, No. 2515.

BY REV. D. C. JACOKES, D. D.

Report of Mass. Board of Education on Proposed Survey of the Commonwealth, No. 869.
Memorandum of the Am. Pub. Health Ass'n, on Legislation affecting Public Health, No. 1750 (1255).
Circular of inquiry by Wis. B'd of Health to School Teachers.
13th Ann. Report of Health Dep., Cincinnati, O., 1879, No. 2009.
Sanitary Engineer for Feb. 15, 1881.

BY HENRY F. LYSTER, M. D.

Separate System of Drainage, No. 326.
Public Health, June 9, 1876.
Uppingham By-Laws and Regulations on House Drainage, No. 966.
Plumber and Sanitary Engineer, Oct., Nov., Dec., 1878.
Statement of Objects of Sanitary Protection Ass'n, Edinburg.
Statement of Objects of Sanitary Protection Ass'n, Newport, R. I., No. 1359.
Twelve Photographs, Illustrative of Influence of Climate on Phthisis and Rheumatism, No. 1595.
Circulars on House Drainage, Mass. State Board of Health, Nos. 1367 and 1599.
Playter's Elementary Anatomy, Physiology and Hygiene, No. 1762.
Sewerage and Sewage Disposal at Providence, R. I., Waring, No. 4784.

BY JOHN H. KELLOGG, M.D.

Nat. Board of Health Bulletin, Sup., No. 7, 1880, and No. 17, 1882; Nos. 3840, 3841.
Collective Investigation of Diphtheria, No. 3842.
Glasgow Sanitary Journal, Nov. 10, 1884.
Report of Proceedings of Ill. State Board of Health, July 2-3, 1885, No. 5060.

BY HENRY B. BAKER, M.D.

Journal of Hygiene (French), for Sept., 1881.
Vol. 35 Med. Chir. Soc. Trans. London, No. 2642.
N. Y. Med. Abstract, April, 1883.
College and Clinical Record, May, 1884.
The Typhoid Fever of America, No. 3905.
Jour. Franklin Inst., Nov., 1884.
Buffalo Med. and Surgical Journal, Aug., 1885.

BY BELA COGSHALL, M.D.

Scientific American, July, 1879.

BY JOHN AVERY, M.D.

Trans. of Mich. State Med. Soc., 1874, No. 73.
Ann. Public Health Ass'n, Vols. IV., V., VI., Nos. 3236, 3237, 3238.
British Med. Jour., Jan.—June, 1883, and Vols. 1, 2, 1884, Nos. 3874, 4483, 5104.
London Lancet, July—Dec., 1882, and Jan.—June, 1883, Nos. 3724, 3879.
Popular Science Monthly, Vol. 25, May—Oct., 1884. No. 4831.
Floating Matter of the Air, No. 2603.
Scientific Am. Sup. Jan.—June, 1884, Vol. 17; Jan.—June, 1882, Vol. 13; Jan.—June, 1883, Vol. 15; July—Dec., 1884, Vol. 18; July—Dec., 1881, Vol. 12; July—Dec., 1882, Vol. 14; Nos. 4462, 3378, 3884, 5116, 3195, 3725.
N. Y. Medical Abstract, July, 1886.
N. Y. Medical Journal, Oct. 23 and 30, 1886.
Prize Essay by A. N. Bell, Schools, No. 5849.
5th Ann. Report State Board of Health of Conn., 1882, No. 3503.

BY C. C. YEMANS.

Report on Plans for securing Records of Deaths, No. 1703.
State Boards of Health, Indiana, etc., Stevens, No. 3395.

Some Fallacies of Statistics, Rumsey, No. 678.
Death Rate of each Sex in Mich., Baker, No. 538.

BY HON. W. W. ROOT, M. D.

Sanitary Work in Lansing, Mich., No. 2031.
Mayor's Address, Aurora, Ill., 1879, No. 1414.

BY M. T. GASS.

Registration of Plumbers, etc., Health Dept, N. Y. City, No. 3215.

BY BION WHELAN, M. D.

Notice to Householders of Presence of Contagious Disease, and Establishing Quarantine, issued by Board of Health of St. Clair City, No. 2624.
"Health Regulations" of the village of Tecumseh.
Orders, Regulations and Suggestions of the Board of Health of Mt. Pleasant, N. Y., No. 4045.
Hygeia—A City of Health, Richardson, No. 744.
The Therapeutic Gazette, Oct. 15, 1885.

BY PROF. VICTOR C. VAUGHAN, M. D.

Le Service Communal de la Desinfection a Bruxelles, No. 4616.

BY GEO. C. RANNEY, M. D.

Physician and Surgeon, August, 1885.

BY G. B. RICHMOND.

Women, Plumbers and Doctors, No. 4888.
Water-Analysis, No. 644.

BY FOSTER PRATT, M. D.

National Board of Health Report, 1885.

BY HERMAN OSTRANDER, M. D.

Human Body, Martin, No. 4021.
Handbook of Physiology, Kirke, Vols. I, II, Nos. 5414, 5415.
Medical Jurisprudence of Insanity, Brown, No. 669.
Medical Thermometry and Human Temperature, No. 667.
Aitkin's Practice of Medicine, Vol. I, No. 1029.

BY PROF. S. W. BAKER.

Am. Soc. Sci. Assoc., 1874, No. 878.
Rep. of Com. concerning San. Conditions of Schools in Philadelphia. No. 1767.
Trans. San. Inst. Great Britain, 1879, No. 4688.

BY H. C. HAHN, PH. D.

Index Catalogue, Vol. VI, No. 5141.

BY C. L. WILBUR.

Bacteria, Magnin-Sternberg, No. 4243.
Phil. Med. Times, Vol. XII, No. 3674.
iemssen, Vol. 2, No. 107.
Fothergill's Handbook of Treatment, No. 1026.

BY G. M'CORMICK, M. D.

Popular Science Monthly, Vol. 4, No. 4503.
Prize Essays, Am. Pub. Health Assoc., 1885, No. 5434.
Our School Houses, Chittenden, No. 1965.
Circular of Information, No. 5, 1881; No. 2773.
Sanitary conditions and Necessities of School Houses and School Life, by James Hibberd; No. 5437.
Sanitary School Circular, N. J. S. B'd of Health, No. 3027.
Our Public Schools, By J. T. Reeve, M. D., No. 1966.
Infectious Diseases and Public Schools, L. W. Baker, No. 5434.
Sanitary Condition of Schools of Lynn, No. 4064.
Sanitary Condition of Schools of Philadelphia, No. 406.

BY STANLEY E. PARKHILL.

Sanitarian, August, 1887.

BY J. C. ESLOW.

American Sanitary Engineering.—Philbrick. No. 2471.
Proposed Plan for a Sewerage System.—Samuel M. Gray, No. 4628.
Sewage Disposal.—Henry Robinson, No. 3925.
Sanitary Engineering.—Cain, No. 1968.

The following table shows the amount and kind of hard paper there was on hand at the time of making the last report, the amount purchased during the year, the amount used, and the amount now on hand:

Kind of Paper.	On hand at Last Report.		Purchased Since Last Report.		Used During the Year.		On hand Now.	
	Reams.	Sheets.	Reams.	Sheets.	Reams.	Sheets.	Reams.	Sheets.
Medium	1	300				60	1	240
Folio Post	9	19	26		18	95	16	404
Demy	8	362				124	8	238
Crown		133				133		
Byron Weston		361						361
Cover Paper	1	250	6		5	334	1	396
Manilla Wrapping-paper	2	350	2		1	155	3	195
Blotting Paper		43		240		46		237
Book Paper		216						216
Foolscap	1	132				116	1	16
Legal cap		240				122		118
Carbon Paper		60						60
Postoffice Paper	1	340				40	1	300
Flat Paper	3	171			1	233	1	418
Bond Paper, or blue laid		100						100

The hard paper has been used in making blank books for use in the office, circulars, announcements and programs for sanitary conventions, printed letters, writing paper, etc. The cover paper has been used for covers to reprints and record-books for weekly reports of diseases, and wrappers for packages of ozone test-paper.

There are now on hand 3,187 sheets of one-half letter and of fool's-cap made from book paper.

At the time of making the last report there were about 2,712 sheets of hard paper of half letter size. Since that time two reams of folio post have been cut into sheets of half-letter size. There are now on hand 1,285 sheets of half-letter paper, and a few sheets of note and half-note size.

There were about 141,419 envelopes on hand when the last report was made; 16,000 of the various kinds in use in the office have been purchased since, making a total of 157,419. There are on hand now of printed envelopes, 47,122; of blank envelopes, 77,791; making a total of 124,913. About 31,506 have been used in the work of the office.

There was on hand at the time of making the last report $36.45 in postage stamps and unused postal-cards, and $38.53 in postal-money, a total of $74.98. Vouchers for postage have been allowed during the year to the amount of $1,200. There is now on hand in postage stamps and unused postal-cards $28.02, and postal money $124.75, a total of $152.77. (This does not include postal-cards printed upon but not yet used.) The cost of postage during the year ending Sept. 30, 1887, has been $1,122.21.

Some of the principal items have been as follows:

Distribution of Annual Reports	$371 92
General Distribution of Documents and Circulars	164 10
Sending Weekly and Monthly Bulletins	27 72
Collection and dissemination of statistics and information in regard to diseases	84 31

Sending announcements and programs for Sanitary Conventions	$44 65
Sending meteorological material to observers	5 98
Regular and special correspondence of the office, and all other postage (including a considerable amount for distribution of documents on the restriction of diphtheria, scarlet fever, typhoid fever and small-pox in localities where those diseases occurred)	423 53
Total	$1,122 21

TOTAL AMOUNT AND CLASSIFICATION OF EXPENDITURES BY THE STATE BOARD OF HEALTH, AS PER VOUCHERS NUMBERS 1369 TO 1455 INCLUSIVE, ALLOWED DURING THE FISCAL YEAR (9 MOS.) ENDING JUNE 30, 1887.

Chemical analyses		$10 00
Engraving, drawing, etc.		1 00
Expenses of Members	Attending Meetings	110 45
	Other official	326 23
Instruments and books		113 40
Paper, stationery, etc.		286 38
Postage	Office	900 00
	Members	1 00
Printing and binding		457 26
Secretary		1,875 00
Special investigations		61 25
Miscellaneous		51 20
Total		$4,193 17

Respectfully submitted,

HENRY B. BAKER,
Secretary.

Having examined the Secretary's annual report of property received, issued and expended during the year ending Sept. 30, 1887, and having compared the foregoing account of expenditures for the fiscal year (9 months) ending June 30, 1887, with the books in the Auditor General's office, I find the same to be correct.

ARTHUR HAZLEWOOD,
Committee on Finances of the Board.

Lansing, Mich., Oct. 11, 1887.

The statement of expenditures for the *calendar* year 1886, is printed on page xxxi of the report for 1886; the statement for the calendar year 1887, will be printed in the Annual Report for 1888, which will be for the fiscal year ending June 30, 1888. The total amount for the calendar year is known approximately, because it is limited by the appropriations, and cannot exceed six thousand dollars.

EXPENDITURES ON ACCOUNT OF THE BOARD.

The appropriations ($6,000) at the disposal of the State Board of Health are for certain specified purposes not including clerk hire, the publication of the annual report, or the expenses in the examination of plans for public buildings; these expenditures *on account of* but not by the board are provided for by other acts of the legislature, and the accounts are kept in other offices, not in the office of the Board of Health: the accounts for clerk hire are kept by the Auditor General, and reported in his Annual Report; the accounts for publication of the annual reports, and for expenses in the examinations of plans for public buildings, are kept by the Board of State Auditors, and are published in the Annual Report of that Board.

ABSTRACTS AND BRIEF ACCOUNTS OF THE PROCEEDINGS AT MEETINGS OF THE STATE BOARD OF HEALTH DURING THE FISCAL YEAR (NINE MONTHS) ENDING JUNE 30, 1887.

REGULAR QUARTERLY MEETING AT LANSING, OCTOBER 1, 1886.

Present: Hon. John Avery, M. D., President; Prof. V. C. Vaughan, M. D., of Ann Arbor; Prof. Henry F. Lyster, M. D., of Detroit; Hon. C. V. Tyler, M. D., of Bay City; Arthur Hazlewood, M. D., of Grand Rapids; and Henry B. Baker, M. D., Secretary.

Correspondence between the secretary of this Board and the secretary of the State Board of Corrections and Charities relative to a proposed plan of sewerage at the Reform School for Boys at Lansing, was read.

The secretary was authorized to publish his paper on "Causation of Pneumonia" in the Annual Report of the Board. (It is printed on pages 246-324 of the Report for 1886.)

A proposed blank for use in a sanitary survey of villages and cities was considered and amended. It was referred to Dr. Tyler, the committee on sanitary survey, for consideration and report at the next meeting.

Dr. Vaughan read a supplementary report on Tyrotoxicon and its relation to cholera infantum. (It is printed on pages 161–164 of the Report for 1886.)

The following resolution, after much deliberation, was adopted:

Resolved, That the regents of the University be respectfully requested to consider the advisability of establishing a laboratory of hygiene, in which original investigations,—chemical, microscopical, and biological,—shall be carried on, and attention shall be given to the subjects of the analysis of water, the adulteration of food, and the practical investigation of other questions in sanitary science; regular reports of important results of laboratory work to be made to the State Board of Health.

Dr. Avery read the report of the committee to investigate an alleged nuisance at Negaunee. This report is printed on pages 167–168 of the Report for 1886.

Dr. Baker read the report of the committee that visited and inspected the Northern Asylum for the Insane at Traverse City, July 27, 1886. It was printed on pages 169–170 in the annual report for 1886.

Dr. Lyster reported, for himself and Dr. Kellogg, they having been appointed a committee to inquire into the influence upon health of boiler iron cells in jails,—a subject which had been referred to this Board by the State Board of Corrections and Charities. Circulars of inquiry designed to secure statistics upon the subject had been sent out, and it had been found that boiler-iron cells not being much used in state prisons or any institutions where prisoners are kept for a considerable time, no statistics are obtainable, and it is impossible to make a study of the subject, except from theoretical considerations. The committee was given further time, and the Secretary was authorized to inform the State Board of Charities of the progress made by the committee.

The Board voted to place rötheln or German measles in the list of "communicable diseases dangerous to the public health."

Dr. Hazlewood, as committee of the Board on finances, reported that he

had examined the financial report of the secretary for the fiscal year 1886, and made a comparison with the books in the office of the Auditor General, and found it to be correct.

REGULAR QUARTERLY MEETING, JANUARY 11, 1887.

Present:—Hon. John Avery, M. D., President; Prof. V. C. Vaughan, M. D.; Prof. Henry F. Lyster, M. D.; Arthur Hazlewood, M. D.; J. H. Kellogg, M. D.; and Henry B. Baker, M. D., Secretary.

Dr. Avery, the President of the Board, gave his annual address at this time because this was the last meeting before the expiration of his term as member of the Board. (The address is printed on pages 174-176 of this Report.)

EXAMINATION OF PLANS FOR PUBLIC BUILDINGS.

Preambles and resolutions were adopted as follows:

WHEREAS, Relative to sec. 7 of act 206, laws of 1881 (§ 418 of Howell's statutes), which law requires boards of charitable, penal and reformatory institutions to submit plans of proposed public buildings to the Board of Corrections and Charities, and to the State Board of Health, for examination and opinion thereon,—certain State institutions have fixed the time and place for such examination and opinion when it was impossible for members of this Board to attend, and have then adopted plans without submitting them to the State Board of Health for its opinion; and,

WHEREAS, The law does not give the boards of State institutions the power to fix absolutely the time for the examination, by the State Board of Health, of plans for proposed public buildings; and

WHEREAS, Because of previous engagements to attend Sanitary Conventions or other special meetings of this Board, it is at some times impracticable for this Board to meet at short notice at a given time or place; therefore,

Resolved, That boards of control of State institutions having plans to submit to this Board under sec. 7 of act 206, laws of 1881, are respectfully requested to file such plans in the office of the Board in the State capitol at such times as that they may be examined at one of the regular meetings of this Board, which meetings occur on the second Tuesday of each January, April, July, and October; and that when this is impracticable or inconvenient, the plans be filed and not less than ten days' time be given this Board to call a special meeting for the purpose of the examination of such plans, at the office of the Board, at the place of the proposed building, or at the place of some sanitary convention, as the circumstances may require.

Resolved, That it will facilitate the work of this Board in the examination of such plans and in the forming of opinions thereon if boards submitting plans will have their architect, or other representative, present at the meeting of this Board, to explain the plans, the proposed location, etc.

Resolved, That a copy of these resolutions be sent to all State Boards of charitable, penal and reformatory institutions in this State.

In accordance with the above resolutions, the following letter was sent to sixty-eight persons and officers:

MICHIGAN STATE BOARD OF HEALTH, OFFICE OF THE SECRETARY,
Lansing, Mich., February 2, 1887.

DEAR SIR:—By this mail I send you a copy of the pamphlet—proceedings of the State Board of Health, at its meeting January 11, 1887. Permit me to ask your attention to the preambles and resolutions relative to plans for public buildings, printed on pages 4 and 5 of this pamphlet, and which resolutions I am directed by the State Board of Health to transmit to officers of state penal, reformatory, and charitable institutions in Michigan.

Very respectfully,

HENRY B. BAKER, Secretary.

PLANS FOR MODEL SCHOOL-HOUSES.

A committee of three (Drs. Avery, Kellogg and Hazlewood) was appointed to draft plans for model school-houses, including plans for ventilation, sewerage and drainage, and disposal of excreta. The committee was authorized to employ an architect to assist them. School boards, or those having in charge the erection of school buildings, were requested to submit plans.

ALLEGED POLLUTION OF DETROIT RIVER.

There was presented considerable correspondence from health officers of cities and others on the Detroit river, below Detroit, concerning the alleged pollution of the river by sewage and garbage from Detroit, and sickness in consequence. This subject was discussed, and was made the special order for the afternoon session of the next regular meeting, Tuesday, April 12, 1887.

LABORATORY OF HYGIENE AT THE UNIVERSITY.

Dr. Lyster, chairman of the committee appointed to confer with the Regents of the University relative to the establishment of a laboratory of hygiene at that institution, made the following report:

Your committee met with the Board of Regents, Dec. 7, 1886, at the University, each member of the committee individually presenting the subject to them:—

Remarks by Henry F. Lyster, M. D.

Dr. Lyster, chairman of the committee, said substantially as follows:

Mr. President and Gentlemen:—We regard the position of the Board of Regents as that of those having in trust the future prosperity of the University of Michigan as well as of its present interests, and that the one is a complement of the other. The time has come in this commonwealth when the people are not satisfied to be the recipients merely of the original ideas and original work of eastern minds and to appropriate the work of others. They recognize the fact that the assimilation of the brainwork and handicraft of others does not develop the strength and power that belongs to those who exercise their minds and hands in labor.

The civilization, enlightenment, and the environment of the people of this State are such that it is perfectly competent for them to enter upon the department of original research in the several branches of applied science and particularly in biology and all that pertains to the preservation of the public health and the limitation of disease.

There is no institution where these branches of study should be pursued other than a laboratory furnished and equipped with all necessary furniture and machinery now approved and in use and to which such additional material and supplies as required may be added.

This laboratory should naturally belong to the State University and have all the advantages of the association with the other departments of learning and of the library. In union there is strength, and in the association of these departments there will be felt an influence in the direction of scientific thought and investigation which will redound to the interest of the University and of the State at large.

The University of Michigan after a history of 50 years, and with over

1,300 students, and after all the good it has done, and all the credit and honor it has reflected upon the name of this State, must develop at once in the department of natural science if it is proposed to keep it among the leading educational institutions in this country.

The University of Cambridge, England, has had a history of more than nine hundred years, and has now about the same number of students in attendance, and is still constructing new departments and new courses of lectures to meet the wants of the times, and this is equally true of the University of Oxford, and of the universities of Berlin, Vienna, Strasburg, and of other European cities and States, as well as of the University of Harvard, and the Johns Hopkins University in this country.

Now if the members of this Board of Regents of the State University are not merely governors *pro tempore*, but are in reality the wardens of the State in whom are reposed the interests of its crowning educational institution in trust, we ask as representatives of the State Board of Health, after 13 years' study of the public health interest, that you ask from the State legislature such an appropriation as may be necessary to organize and equip a suitable laboratory of biology and hygiene which, in the opinion of the Board which we represent, is absolutely essential to the best interests of the people of this State for their preservation and well-being.

Remarks by Victor C. Vaughan, M. D., Ph. D.

Dr. Vaughan spoke substantially as follows:

The degree to which a nation or community has advanced in civilization may be measured by the attention it gives to the protection of the health and the prolongation of the lives of its citizens. In the dark ages people lived in filth, were poisoned by their own excretions, and died by the thousands. Between March and July, 1348, there perished in Florence alone more than 100,000 persons from the black death. Geneva lost 40,000 inhabitants, Naples 60,000, Venice 70,000, and in the brief space of four years there perished in the whole of Europe not less than 40,000,000 of people poisoned by the filth which they had accumulated about themselves. In 1665 the same filth disease swept from London more than 100,000 of its population. By some attention to cleanliness the black death has been quite banished from Europe; but other filth diseases still prevail in both hemispheres. In our own State there are reported on an average 500 deaths annually from typhoid fever. There is reason to believe that this is actually about one-half the true number, and we would be safe in saying that there are 1,000 deaths each year in this State from typhoid fever alone, and this is much less than it was before the State Board of Health began its work. For each death from typhoid fever there are on an average 15 persons sick. This gives 15,000 cases of typhoid fever per year in this State, and if sanitary science was thoroughly understood by the people there need not be a single case of this disease. This may seem to be a very strong statement, but in one place its truth has been quite nearly demonstrated. From 1852 to 1859 the annual death-rate from typhoid fever in Munich per 10,000 inhabitants was 24.2. After the establishment of the famous hygienic laboratory at Munich, and as a result of the investigations made at that laboratory, certain municipal sanitary improvements have been made and the death rate from typhoid fever has decreased until in 1884 it was only 1.4 per 10,000. In a

population of 250,000 this is an annual saving of over 500 lives, and more than 7,500 cases of illness from this one disease alone. But typhoid fever is not the only preventable disease. The list is a long one, and embraces such dreaded scourges as diphtheria, scarlet fever and cholera. Can the educational facilities of the State be better employed than in giving instructions in methods of preserving the health? The State teaches the literature and language of ancient Greece; should it not give some attention to the health and lives of its own citizens? It makes doctors who are to cure diseases; would it not be well to give a little attention to the prevention of disease? It gives its students instruction in the means of preventing disease among the lower animals; shall it leave from its curriculum altogether the study of the prevention of diseases which afflict human life? Are the lives of its citizens of so little value?

Nearly every civilized country is now manifesting great interest in the protection of the health and prolongation of the lives of its citizens. Germany has established a number of hygienic institutes in connection with its universities, and all students are instructed in sanitary science.

The already famous Imperial Laboratory of Hygiene at Berlin, under the charge of Prof. Koch, has accomplished a great work. Here the contagious nature of consumption (the most dreaded of all diseases in this latitude) has been demonstrated, and the public is now being instructed in the methods of procedure necessary to limit its spread, and the probabilities are that by intelligent care in this direction the death-rate from this disease will be greatly decreased.

France has given much aid to practical hygiene, and the labors of Pasteur on anthrax and hydrophobia are known and appreciated everywhere.

The municipal laboratory of Paris is maintained by the city, and for a small fee anyone may have any sample of food or drink tested for adulterations. In this way the people of Paris have become quite thoroughly posted concerning adulterations, and from this knowledge the wisest and most satisfactory enactments against food adulterations have been made and are enforced.

England, through its Local Government Board has carried on many important hygienic investigations, among which may be mentioned the recent studies which have demonstrated the fact that scarlet fever may be transferred from cows to children through milk.

In the United States much money has been spent in health work. Several States have salaried analysts, milk inspectors, etc.

The Legislature of Louisiana two years ago appropriated $16,000 to enable Dr. Holt, of the State Board of Health, to make some experiments in the disinfection of ships. As a result of those experiments, which were successful, yellow fever has been practically kept out of the State. The same State maintains the disinfection of ships at the mouth of the Mississippi, and thus protects not only itself but the whole of the Mississippi Valley. The State of Mississippi appropriates $45,000 annually for health work.

The policy of Michigan in its health work, as in other departments of State legislation, has been to educate the people. The Michigan State Board of Health is not an executive body; its powers are wholly advisory, and it has accomplished the great work, for which it is universally given credit, by educational means; these it hopes to strengthen and widen by the laboratory of practical hygiene which you have been asked to establish.

There is needed some place where every health officer of a town, village or city can have samples of drinking water or articles of food tested for impurities and adulterations. This could not be done for nothing, but at a minimum fee, and the money obtained for work of this kind could be turned into the laboratory fund; this would give every locality in the State a direct interest in the University, and all could see the practical benefit to be derived from this department. Reflexly this would aid the University and lead to its more hearty support by the people.

There are constantly being presented problems in the study of the origin and spread of disease which can be solved only with the aid of a well-equipped laboratory. One or two illustrations will serve to make this plain. A grocer sells to fifty people some meat which is apparently all right, but it makes everybody sick. What is the cause of the trouble? This can be ascertained only by careful and long study with all the aid that science can bring to bear. The grocer can not be expected to pay for this investigation because he is not to blame, and certainly those poisoned can not be asked to pay for it. The State should do the work, should endeavor to ascertain the cause and instruct its citizens against future similar calamities. Again, the question of the best method of the disposal of garbage is one in which every householder in the State is directly interested, and which can be determined only by laboratory experimentation. The effects of slightly decomposed milk and the methods of detecting and preventing such decomposition are questions which need solution. These and a hundred other problems are of public interest and can be solved only by laboratory work.

Then this laboratory should be made an educational center in hygienic subjects. The results of the work done in it should, through the State Board of Health, be made known to the people.

There should also be carried on in such a laboratory original investigations concerning the causation, nature and prevention of disease. There can be no question as to the duty of the State in protecting the lives of its citizens, and no one can deny the fact that education in sanitary matters is one of the most powerful protective aids that can be furnished any people.

Again, the instruction offered by such a laboratory to its students will make them fit advisers in all sanitary matters to the various communities in which they live.

The following is a proposed plan of study to be followed in such a laboratory:

Schedule of Studies.

I. THE AIR.—A. *Physical Studies:* (a) Observations on temperatures and the influence of temperature on health. (b) Determinations of air pressure and the effects of variations in air pressure upon diseases of the lungs and heart. (c) Determinations of air moisture and the effects of climate as affected by moisture. (d) Determinations of ozone and a study of its relations to disease. (e) Ventilation of houses.

B. *Chemical Studies:* (a) Analysis of air and determination of carbonic acid gas. (b) Study of organic matter in the air and its effect upon health. (c) Microscopical studies of the air.

II. THE SOIL.—A. *Physical Studies of the Soil:*—(a) Determination of porosity. (b) Determination of the capacity of the soil for the absorption of water. (c) Determination of moisture. (d) Determination of temperature.

B. *Chemical Examination of the Soil:* (a) Determination of organic matter. (b) Analysis of ground air. (c) Analysis of ground water. (d) Microscopical examination of soil. (e) Diseases due to soil pollution.

III. WATER.—(a) Physical properties. (b) Chemical analysis. (c) Microscopical examination. (d) Diseases due to impure water.

IV. Foods.—(a) Nutritive value of foods. (b) Economical value of foods. (c) Study of individual foods. (d) Analysis of foods. (e) Detection of adulterations.

V. Clothing.—(a) Physical properties of clothing. (b) Chemical properties of clothing. (c) Hygienic considerations of clothing.

VI. Healthy Homes.—(a) Sanitary locations. (b) Sanitary properties of building material. (c) Study of air, space, and ventilation. (d) The size, arrangement, and care of rooms. (e) Study of temperature and methods of heating. (f) Water-supply. (g) Disposal of waste.

VII.—Contagious Diseases.—(a) The nature and history of contagious diseases. (b) Study of germs. (c) Restriction of contagious diseases. (d) Vaccination. (e) Disinfectants and disinfection.

VIII. Original Investigations.—I may state that the building should be about 80x60 feet, two stories high, and with basement. It would require furnishings and apparatus. There would be need for books and periodicals, as the general library is almost wholly wanting in books on sanitary subjects.

Abstract of Remarks by Henry B. Baker, M.D.

Dr. Baker said he wished to endorse the outline which had been presented by .Dr. Vaughan, and to emphasize the necessity of laboratory work as an aid in teaching sanitary science. It was generally understood that for the successful teaching of chemistry, laboratory work was essential, but he thought it was not so well understood as it should be, that for successful teaching in sanitary science a well-equipped laboratory is essential. He hoped the Regents would ask the Legislature for means to establish the laboratory, not because it has been recommended by the State Board of Health, but because it is right, and will make the University more useful in promoting the welfare of the people. The University can do no nobler work. He assumed that no elaborate argument was needed to convince the Regents of the University that mental training in sanitary science was worthy to rank higher than training in any science or art or literature. The question should not be, why establish an effective system of training in sanitary science? It should be, why has this not been done long ago? But mankind had to wait centuries, until many universities and educational systems had grown old, before the question was raised, "What knowledge is of most worth?" What sort of mental training is of most benefit to mankind? He supposed that all present had read Herbert Spencer's work on education which started with that inquiry, and which laid down a few propositions which seemed so true as to require no proof. One conclusion was, "That knowledge is of most worth which tends directly to preserve life." Another is, in effect, that next in value is knowledge which tends indirectly to preserve life. And compared with such knowledge and training in such directions, much that has been taught in schools and in universities must be placed low in the scale of immediate and prospective usefulness.

The University is charged with the noble duty of training the minds of those who are to become the leaders of thought throughout this State and in the nation. The State cannot afford to have those who are to be the leaders in thought throughout the State untrained in sanitary science—ignorant of that knowledge which is of most worth. He trusted that the Regents would do all in their power to establish a laboratory of sanitary science, and a system of instruction therein, and as rapidly as possible raise the system to that high plane to which sanitary science is entitled by reason of its great usefulness to mankind.

The report of this committee was discussed, and the proposed laboratory and system of instruction heartily supported by all present. In the course of the discussion, Dr. Baker presented the following:

The highest education, and that of most utility, is that which best fits one for right living, in every sense—that which has to do with the preservation of life and the perfection of physical and mental health. To supply this higher education, in recent times, the several sciences have been laid under contribution to form a science of hygiene, usually called sanitary science. So long as the State University fails to supply this higher education which is of most utility and vital importance to the people of this State, or continues to give it a place inferior to the ordinary sciences, the University cannot expect more than half-hearted support by those who have at heart the highest interests of the people.

The State Board of Health passed a resolution asking the regents of the University to consider the advisability of establishing a laboratory of hygiene, in which original investigations should be carried on, etc.; but it was not considerered that this was the only use for a laboratory. If it were, the Board of Health itself might more properly ask the Legislature to grant it an appropriation, so it could do what some other government boards of health do, namely: Have original investigations made under its own direction. The cause of that disease which causes most deaths throughout the world has apparently been discovered through such investigations under the direction of the Board of Health in Germany. But this State Board of Health had also in view, and its committee placed before the regents, the idea of the great importance of such a laboratory, for the purpose of teaching, in the best manner, at the University of Michigan, "That knowledge which is of most worth."

In the Governor's message it is shown that the regents have a willingness, but not a great desire to advance in this direction. In that case, it is possible that a laboratory of hygiene might be more enthusiastically supported in connection with the State Agricultural College, in which great attention is given to some of the sciences which lead up to and contribute to sanitary science, and at the head of one department of which is Prof. Kedzie, an ex-President of this Board and of the American Public Health Association, and a sanitarian well known in Michigan and elsewhere.

The proposition to maintain such a laboratory at the University, however, has come about because of recent valuable work done in the present imperfect laboratory at the University, by Prof. Vaughan, who lectures on sanitary science, in the school of political economy, at the University, and whose original investigations into the nature of the cause of numerous cases of poisoning in this State have resulted in learning, not only the nature of that cause, but probably also of the cause of one of the most important diseases of mankind. Prof. Vaughan's important researches are already known and acknowledged throughout the civilized world. It is a mistake, therefore, to suppose that it is an entirely new scheme to establish a laboratory of hygiene at the Michigan University. It is not an untried experiment. It is a proposition to give proper room, opportunity and support to a laboratory which has already made contributions of incalculable value for the promotion of human welfare; and a proposition to provide for better instruction in a sub-

ject now imperfectly provided for, but which is the most important of all subjects which receive attention at the State University.

The following memorial was then unanimously adopted and signed:

To the Honorable the Senate and House of Representatives of the State of Michigan:

Your memorialists, the members of the State Board of Health, respectfully represent that:

Whereas, The highest education and that of most use, is that which best fits mankind for right living, that which tends directly to the preservation of life, and to the perfection of physical and mental health and strength; and,

Whereas, The teaching of such "knowledge of most worth" at the University of Michigan is not yet well provided for; therefore,

Resolved, That we earnestly memorialize your honorable bodies to take such action as shall lead to the maintenance of a well-equipped laboratory of hygiene at the University of Michigan, and of such instruction in sanitary science at that institution, as shall place that subject on a plane not inferior to that of any other subject taught at the University.

The secretary presented to the Board a very handsome and artistic "Certificate of Thanks" (24x30 inches), which had been awarded to the Michigan State Board of Health by the International Health Exhibition of 1884, in London, England, for "services rendered," and which was received through the Department of State at Washington.

Dr. Baker reported his attendance, and much valuable information gained at the annual meeting of the conference of State and Provincial Boards of Health, at Toronto, Ontario, in October, 1886. (This report is printed on pages 176-183 of the Report for 1886.)

REGULAR QUARTERLY MEETING AT LANSING, APRIL 12, 1887.

Present: Drs. Avery, Vaughan, Tyler, Kellogg, Hazlewood, Lyster and Baker.

Dr. Hazlewood said this Board had taken an active part in securing to the people of this State safety in the use of illuminating oil. Another article just as important should be put under supervision. He referred to distilled and fermented liquors and their impurities and adulterations.

The subject was discussed at considerable length by the members present.

The opinion seemed to prevail that the adulterations in alcoholic drinks were of less consequence than the alcohol itself in baneful effects upon those who used them; that investigations as to adulterations, involving large numbers of analyses, would lead to expenses beyond the power of this Board to pay, and require the time of an investigator more than could be devoted to it by a member of this Board; that there was, however, much that could be collected by a committee, of work done in other States of value because applicable to the subject in this State.

Finally, a resolution, offered by Dr, Lyster, was adopted, as follows:

Resolved, That a committee of three be appointed by the President to report upon the subject of the physiological and pathological action of alcoholic liquors, upon the consumers of alcoholic liquors as beverages, this work to include the subject of adulterations, and an estimate of the quantities consumed as beverages in Michigan.

Subsequently. the president announced as the committee under the foregoing resolution, Drs. Lyster, Vaughan and Hazlewood.

Subsequently, on motion, this committee was made a standing committee of the Board.

This being the annual meeting for the election of officers, Hon. John Avery was re-elected president of the Board.

The report of Henry B. Baker, M. D., secretary, on the Sewerage of Marquette, was ordered printed in the Annual Report. (It is printed on pages 170-173 of this Report.)

The subject of compensation of health officers was brought up, and Drs. Hazlewood and Baker were appointed a committee to embody certain questions in a circular to be sent to local health officers.

Dr. Kellogg called attention to the explosive powers of gasoline. On motion, he was authorized to prepare a circular on the dangers in gasoline, and the use and care of gasoline. (This circular is printed on pages 24-28 of this Report.)

Dr. Vaughan made a supplementary statement concerning tyrotoxicon. He was authorized to prepare a circular on this poison and its relation to cholera infantum, for distribution throughout the State. (This circular is embodied in the article on tyrotoxicon printed on pages 177-185 of this Report.)

The Secretary then read the report of the committee (Drs. Avery and Baker) appointed to examine the ventilation of the cell-blocks and shops at the State House of Correction at Ionia. The report was accepted and adopted, and the Secretary was authorized to transmit a copy to the Board of Control of that institution. The substance of the report is as follows:

STATE HOUSE OF CORRECTION AT IONIA.

VENTILATION OF THE CELL BLOCKS.

We were told that the cell-blocks in the different wards were similar to those which we examined and which were in ward D. From each cell there is a foul-air duct about 4x8 inches, which leads up to a common duct over the center of the cell-block, which is about two feet by three, made of brick, running the entire length of the block, being closed at the end most distant from the central building, and at the central building leading up to one of the towers, at the top of which the air is discharged. In each cell there are two openings into the foul air ducts, one at the floor in which the night-pail is placed, another, a smaller one, at the ceiling. In no cell did we find the air passing out through the opening near the floor in which the night pail is placed. The velocity of the current at the upper opening was greatest in the cells nearest the main building, and least at the other end of the cell-block. The velocity was greater in the middle tier than in the lower tier. (It would probably have been found still greater in the upper tier, but time did not permit of this being ascertained on this visit.)

We recommend that the upper opening into the foul-air duct in every cell be closed. This will make each foul-air shaft nearly six feet longer, and will make the velocity of the current out at the lower opening slightly greater than it is now at the upper. It will cause the out-current of air to pass by the night-pail. We recommend that the common foul-air duct along the top of the cell-block be permanently divided across, so that one-half of the cells may be ventilated up to and out through the two ventilating towers on the roof, most distant from the central building, and now unused. The common foul-air duct would need to be permanently divided, also half way between the two ventilating towers mentioned; and probably there would need to be a coil of steam pipe in each section for use in certain states of the atmosphere.

In ward D. cell No, 1, west side of lower tier we found the air passing at the rate of about 1,733 cubic feet per hour, In cell No. 14, near the middle of the cell-block, the movement of the air was about 1,200 cubic feet per hour; while in cell No 26, the distant end of the cell-block, the movement was only about 400 cubic feet per hour. In the second tier, cell no 53, the movement of the air was about 2,056 cubic feet per hour. In cell No. 66, near the middle of the block, it was 1,733 cubic feet per hour, and in cell No. 78 only about 400 cubic feet per hour. In cell no 91, middle of the center tier on east side, about 933 cubic feet per hour. Cell 104, 2,533 cubic feet per hour.

About 156 men occupy the cells in the block. The inlets for fresh air are about 36 in number, 18 on either side of the building, a few feet from the ground. They are four-inch round openings. Steam pipes run around the walls of the room in front of these openings. These fresh-air openings would seem to be insufficient, because, in order that sufficient air should pass to supply the 156 men, the air would have to pass with such velocity that it could not be warmed by the pipes. We recommend that additional fresh-air inlets be provided at the end of the wing most distant from the central building, and that the fresh air be passed over steam radiators so that it can be properly warmed before it reaches the cells.

So long as the fresh air admitted to the ward is colder than the air which has been used in the cells, and there is no opening in the ceiling, the least ventilated cells in the highest tier will be supplied with very foul air. If the fresh air shall be so warmed before it is used that it is lighter than the air which has been used in the cells, it will make it possible for occupants of the upper tier of cells to breathe air of much greater purity than has been supplied to them.

VENTILATION OF THE SHOPS.

In one of the cigar shops (the "south room") the recommendation by Dr. Avery, a former committee of this Board, had been carried out, and galvanized iron foul-air ducts from near the floor out through the roof have been put in. The first one of these ducts which we examined was doing the work expected of it. About 5,550 cubic feet of foul air per hour were passing out, and very foul it was. This one duct could remove a quantity of air about sufficient for two men, considering the character of the work engaged in. About sixty men are employed in this room. There were twelve ducts in the room, of which only four were doing the work they were planned to do. These four, two on each side of the room, were grouped, and led to a common duct in the garret which went out through the ridge in the ventilating tower. A search in the garret revealed why the others were not working. The common duct for one group of four had been trampled down so that it could not take out the air from below, a piece about 2x3 feet had been cut from the side of the other main or common duct, and that was removing air from the garret, but not from the room below. We replaced the section, went below and then found the four ducts, leading to that central one, were removing foul air from the shop. The steam coils placed in each of the common ducts in the garret were not heated, and only part of the steam pipes in the shop were warmed. It seems certain then that the method recommended by Dr. Avery some years ago is a satisfactory one, so long as it is kept intact, and providing the foul-air ducts are large enough and numerous enough; but impaired, as just described, and insufficient in number, the ventilation was not good and the air was abominable. In the cigar shop which adjoined this, where there was no attempt at ventilation, the air was in a worse condition. No human being should be required to breathe such air. About one hundred men are employed in that room.

The several shops that are not ventilated should have this method recommended by Dr. Avery applied to them, and the ducts should be large and numerous enough to carry off under unfavorable conditions of temperature at least 2,000 cubic feet of air per hour per man. Then each shop should have provision for the entrance of fresh air, as follows: An opening through the outer wall at the ceiling of the room underneath should admit fresh air through a tin or galvanized iron pipe along the ceiling to the middle of the room where an opening in the ceiling and floor above should allow the fresh air to pass through an indirect steam radiator into the cigar shop above. Over the radiator, in the shop, there should be a sheet-iron top to prevent dust from settling in the radiator at such times as little air is passing, and on the four sides there should be wire screen about three feet high, through which the warmed fresh air should enter the shop. A sheet-iron jacket around the radiator should extend about six inches above the floor, so that when the floor is swept, dust and small articles would not be swept down into the fresh-air inlet. In the cigar shop "south room" there should be three such fresh-air inlets, the combined area of which should be sufficient to supply two thousand cubic feet of air per hour per man in the shop, and to do this when the difference in temperature between the indoor and outdoor air is not great. Similar recommendations will apply to each of the cigar shops in which many men work. The fresh-air inlets will require less attention, and the current through them will be most constant, if they are through the east side of the building. In the cigar shops this is practicable, and is what we recommend.

ABSTRACTS OF QUARTERLY REPORTS PRESENTED BY THE SECRETARY AT REGULAR MEETINGS OF THE BOARD, OF WORK DONE IN THE OFFICE OF THE STATE BOARD OF HEALTH.

QUARTER ENDING OCT. 13, 1885.

The proceedings of the Kalamazoo Sanitary Convention have been edited, the proof read, and the distribution of the pamphlet commenced. Most of the proof on the annual report for 1885 has been read, and the printing on the report completed. The preparation of manuscript for the annual report for 1886 has gone on, and a portion of it has been sent to the printer, that part relating to meteorology.

Correspondence relative to dangerous communicable diseases has gone on as usual. The office during the quarter has received information of 62 outbreaks of typhoid fever in Michigan; 83 outbreaks of diphtheria, and 31 of scarlet fever. To such localities have been sent about 650 documents on the Prevention and Restriction of Typhoid Fever; about 1,200 on the Prevention and Restriction of Diphtheria, and about 400 on the Prevention and Restriction of Scarlet Fever, with requests that they be distributed where they will be likely to be read. Health officers are now more than formerly asking for such documents; and we receive evidence that they are generally distributed.

A general distribution has been made of about 3,300 circulars to physicians in Michigan, calling their attention to the law relative to reporting cases of communicable diseases, and to the desirability of efforts for the restriction of typhoid fever.

Since the beginning of the quarter there have been received and entered in the library 92 books and pamphlets, mostly exchanges.

The plates of the document on the Prevention and Restriction of Scarlet Fever have been amended, and 10,000 copies of the document have been printed.

Much time has been devoted to the preparation of a blank, and letter to presidents of villages, for a proposed sanitary survey. Copies were sent to the members of this Board, but replies from all not having been received the blank has not been printed.

A new blank, "K," for special final report relative to communicable diseases, has been devised, has received the approval of all the members, and 500 copies have been printed. It is expected that it will call out more exact information in regard to the methods employed by health officers in preventing the spread of dangerous communicable diseases.

Preparations were made for the sanitary convention at Coldwater, which passed off successfully Sept. 9 and 10. Preparations for the sanitary convention at Big Rapids have also proceeded, this office coöperating as usual. Some of the persons who read papers at Coldwater, and others who are on the program for the Big Rapids Convention, have been supplied with literature from the library of this Board, with the promise of good results.

The printed list of health officers in 1886–7 has been sent to all health officers in Michigan. To 455 health officers of townships have been sent the proceedings of the Ypsilanti Sanitary Convention; and the proceedings of the Howell Convention were sent to 533 health officers of townships. To all the health officers of cities and villages have been sent the proceedings of

the meeting of the Board, July 13, 1886, and the proceedings of the Conventions at Howell and Ypsilanti. The proceedings of the Board, July 13, 1886, were sent to sanitary journals and other exchanges.

QUARTER ENDING JANUARY 11, 1887.

The proceedings of the Coldwater and Big Rapids Sanitary Conventions have been edited, and the manuscript for the Coldwater Convention has been sent to the printer. The printing of the annual report for 1886 has gone on until 160 pages have been completed.

The office during the quarter has received information of, and has taken action relative to, 111 outbreaks of diphtheria in Michigan; 63 outbreaks of scarlet fever; and 48 outbreaks of typhoid fever. To such localities there have been sent, for distribution, about 480 documents on the Prevention of Typhoid Fever; about 650 on the Restriction and Prevention of Scarlet Fever; and about 1,100 documents on the Restriction and Prevention of Diphtheria.

Annual reports of the Board for 1885 have been sent out as follows: 1,125 to health officers of cities, villages, and townships; 515 with reprint No. 250 to sanitary journals and exchanges, meteorological observers, correspondents, members and ex-members of this Board, secretaries of other State boards of health, secretaries of State medical societies, members of the national board of health, the governor and ex-governors, members of State boards, and superintendents of State institutions, and State officers in Michigan; 566 to clerks and presidents of cities and villages; about 150 to sanitarians in Michigan; about 70 to health officers outside of the State; about 50 to sanitarians in other States, members of congress from Michigan, presidents and members of other State boards of health.

One thousand copies of the proceedings of the October meeting of this Board have been distributed.

The usual large distribution has been made of blanks and circulars for annual reports by the 1,432 clerks and the 1,431 health officers of local boards of health in Michigan.

Since the beginning of the quarter there have been received and entered in the library about 80 books and pamphlets, mostly exchanges.

During the quarter the secretary has attended the International Conference of Representatives of State and Provincial Boards of Health, at Toronto, Ont. (His report is printed on pages 176-188 of the Report for 1886.), also the sanitary convention at Big Rapids, under the auspices of this Board. He has also visited Marquette on the invitation of the Marquette Board of Sewer Commissioners to advise with them relative to a proper place as outlet for their sewers. On his return he made a written report (printed on pages 170–173 of this Report). He also visited Ann Arbor with Drs. Lyster and Vaughan as a committee of this Board, to urge before the University regents the establishing of a laboratory of hygiene.

The regular meteorological work has been kept up, including the compilation (up to December) of all subjects in meteorology for 1886, except the barometer. Eighteen diagrams illustrating the relation of sickness from different diseases to the meteorological conditions have been made and sent to the engraver.

The reports of sickness and the order of prevalence of diseases as reported on the weekly report cards for the first nine months of 1886 have been com-

piled during this quarter, and placed in tabular form. From this has also been made up the exhibit stating the observers and the number of cards received from each, and also the working blanks for the further compilation of the statistics of sickness and of climate with a view to learning the "Causes of Sickness" in Michigan.

QUARTER ENDING TUESDAY, APRIL 11, 1887.

The proof of the Proceedings of the Coldwater and Big Rapids Sanitary Conventions has been read. The Coldwater Convention is ready for distribution, and a few copies have been sent out.

The office during the quarter has received information of, and has taken action relative to 8 outbreaks of typhoid fever in Michigan; 75 outbreaks of scarlet fever, and 94 outbreaks of diphtheria. To such localities there have been sent, for distribution to neighbors of those sick, about 80 documents on the Prevention of Typhoid Fever, about 1,125 documents on the Restriction and Prevention of Scarlet Fever; and about 1,410 documents on the Restriction and Prevention of Diphtheria. No small-pox has been reported in Michigan during the past three months.

Since the beginning of the quarter, there have been received and entered in the library 128 books and pamphlets, mostly in exchange for publications by this Board.

The usual annual demand on the proper officers for return of names and addresses of health officers for 1887–8 has been made. Blanks and return envelopes for this purpose were sent to over 1,400 townships, villages, and cities.

The annual report for 1885 has been sent to addresses supplied by Drs. Lyster, Hazlewood, Kellogg, Avery, and Baker, in all about 325 copies.

About 1,500 copies of the proceedings of the January meeting have been distributed where it was thought they would do most good.

During the quarter, Dr. Avery and the Secretary, in conformity with an order of the Board, visited the House of Correction at Ionia, and the Reform School at Lansing, to examine their sanitary condition.

The Secretary visited Brooklyn, N. Y., to read a paper, Feb. 24, on Causation of Pneumonia, before the Brooklyn Pathological Society, and to gain from that society all possible criticisms in order to perfect the evidence bearing upon that subject. In this he was successful, as the subject was very thoroughly discussed. He took notes of the points raised, so that further study can be given them.

Compilation of weekly postal-card reports of sickness in 1886, has gone on satisfactorily.

The article on diphtheria in Michigan in 1886, for the report for 1886, is nearly done, as are also those for scarlet fever and small-pox. For this purpose, the annual reports of health officers and clerks of local boards for 1886 have been compiled.

The work of making a card catalogue of the library has been renewed. About 4,000 cards are now made.

The meteorological tables for the year 1886 are nearly all made up, and one of the diagrams, that of velocity of wind at seven stations in Michigan, is completed.

This fifteenth Annual Report is respectfully submitted.

HENRY B. BAKER, *Secretary.*

THE FIRST QUARTERLY REPORT OF THE MICHIGAN STATE LABORATORY OF HYGIENE.

BY PROF. VICTOR C. VAUGHAN, M. D., PH. D., MEMBER OF THE STATE BOARD OF HEALTH, AND DIRECTOR OF THE LABORATORY OF HYGIENE.

To the Michigan State Board of Health:

GENTLEMEN: In accordance with the recommendation made by you at your meeting in October, 1886, the Regents of the State University asked the Legislature for an appropriation to build and equip a laboratory of practical hygiene in which original investigations as to the causation and nature of diseases might be made. A portion of the amount asked was granted by the Legislature, and in June, 1887, the Regents established a department of hygiene, appointed the undersigned director of the laboratory and professor of hygiene, and Frederick G. Novy instructor in hygiene. The laboratory building is now in process of erection, and will be ready for occupancy in October, 1888. However, last October, Mr. Novy and I began our work, using rooms and apparatus belonging to the chemical laboratory. The first few weeks were spent in investigating the fatal cases of milk-poisoning, which occurred near Milan. The mystery connected with these cases was cleared up, unjust accusations were hushed, and the great care necessary to prevent milk-poisoning was emphasized. Later, Mr. Novy's investigations showed the fraud being practiced upon the people in the so-called new local anæsthetic, stenocarpine. The exposure of this fraud was so complete that the mixture has been withdrawn from the market.

The greater part of the quarter's work has been given to the investigation of the epidemic of typhoid fever at Iron Mountain. If this work will cause people to give more attention to the purity of their drinking water, many lives will be saved. Reports of these investigations are herewith submitted to you. Besides the above, we have made analyses of water, with the view of selecting a source of public supply at Albion.

Respectfully,

VICTOR C. VAUGHAN,

Director of the Michigan State Laboratory of Hygiene.

EXPERIMENTAL STUDIES ON THE CAUSATION OF TYPHOID FEVER WITH SPECIAL REFERENCE TO THE OUTBREAK AT IRON MOUNTAIN, MICH.—PRELIMINARY REPORT.*

BY VICTOR C. VAUGHAN, M D., PH. D., AND FREDERICK G. NOVY, M. S.

Last October, having heard of the prevalence of a severe epidemic of typhoid fever at Iron Mountain, Michigan, we requested Dr. G. B. Johnson, a physician of that place, to forward to us a sample of the drinking water, used by families in which the disease had appeared. This request was immediately complied with, and we determined to make the most thorough tests possible. The ordinary sanitary analysis, which consists in the determination of free and albuminoid ammonia, chlorine, nitrates and nitrites, we determined would be altogether inadequate. Besides, as we afterwards learned, such an analysis had already been made by the competent chemists of the Chapin mine at Iron Mountain. The results of this analysis, together with those of other waters in the village, made by the same chemists, will be given further on.

After much deliberation we determined to inoculate sterilized meat preparations and sterilized milk with the suspected water, and then to keep the material at or near the temperature of the human body for varying periods of time, and to ascertain whether or not there would be any poisons developed by the bacteria, which were suspected of being in the water. The following are the details of the method: A number of Erlenmeyer flasks of 400 c. c. capacity were thoroughly cleansed and rinsed with distilled water; then dried in an air-bath. When dry, they were tightly closed with plugs of cotton and heated for two hours at 140–150°C.

A litre of fresh milk was placed in a large flask, plugged with cotton, and heated in a Koch's steam sterilizing apparatus for over three hours. The flask was then taken out and, while yet warm, its contents were transferred by means of a sterilized graduate and sterilized funnel, in portions of 150 c. c. each, to the above mentioned sterilized, small flasks. The transfer was made as speedily as possible and the flasks were immediately plugged with cotton and capped with pieces of filter-paper, which were held in position by means of rubber bands. The flasks, thus prepared, were placed in the steam sterilizing apparatus and heated for two hours. This was found to produce perfect sterilization.

*This is part of the First Quarterly Report to the State Board of Health, of work done in the Michigan State Laboratory of Hygiene, at the State University.

One pound of lean beef was chopped up finely and treated with one litre of distilled water. The whole was set aside in a cool place for twenty-four hours, being occasionally well shaken. It was then filtered through cloth, the filtrate was diluted to one litre with distilled water, placed in a large beaker and heated almost to boiling. Then twenty-one grams of peptone and five grams of pure sodium chloride were added. While still hot, the solution was carefully neutralized with sodium carbonate, then placed in the steam sterilizer and heated for two and one-half hours. After removal and when nearly cold it was filtered through paper; the filtrate was made up to one litre with distilled water, placed in a large assay flask, plugged with cotton, and heated in the steam sterilizer for three hours. After cooling it was transferred to the sterilized flasks, which were plugged with cotton and heated for two hours in the steam sterilizer.

November 9, 3 P. M., some of these flasks were inoculated with Iron Mountain water; others with some water which we had received from Lansing, Mich., and which had been used by a family, some members of which suffered from typhoid fever; and one each of the milk and meat preparation was left without inoculation and used as controls.

Two of the meat and two of the milk flasks were inoculated with 30 c. c. each of the Iron Mountain water, and one meat and one milk flask with 50 c. c. each of the same water. The same number of flasks and the same amount of water were used with the Lansing water. Thus we had six flasks inoculated with the Iron Mountain water, six with the Lansing water, and two controls.

These flasks were then placed in a Koch's vegetation apparatus and kept at from 30°–38°c.

Nov. 11, 47½ hours after the inoculations were made, four flasks, one containing meat preparation and Iron Mountain water, the second, milk and Iron Mountain water, the third, meat preparation and Lansing water, and the fourth, milk and Lansing water, were removed from the vegetation trough and examined.

The meat preparation inoculated with Iron Mountain water had a strong, repulsive odor, showed an abundant, white bacterial growth, and was neutral in reaction. It was filtered, rendered feebly acid with hydrochloric acid, extracted with ether, then rendered alkaline with sodium carbonate, and extracted successively with ether, benzole and amylic alcohol.

The acid ether extract was allowed to evaporate spontaneously, the residue was dissolved in alcohol, acidulated with dilute hydrochloric acid and evaporated on the water bath. The reddish residue was dissolved in water, filtered and tested for ptomaines. It gave no alkaloidal reactions and contained no poison.

The alkaline ether extract, treated in the same manner as the acid extract, gave slight precipitates with phosphomolybdic acid and platinum chloride, but was also inert.

The alkaline benzole extract gave no alkaloidal reaction and was free from poisonous properties.

The amylic alcohol extract gave slight precipitates, but if it contained any poison the amount was too small to have any effect upon animals.

After the above extractions had been made, the fluid was again rendered acid with dilute hydrochloric acid, and then evaporated in vacuo at 40°C. The residue was treated with absolute alcohol, filtered and again evaporated

in vacuo, again taken up with absolute alcohol and now allowed to evaporate spontaneously. The final residue dissolved in water gave precipitates with many of the alkaloidal reagents, but showed no poisonous properties.

We were now convinced that no poison had yet developed in the meat preparation inoculated with the Iron Mountain water.

Similar examinations were made with the milk and Iron Mountain water, the meat preparation and Lansing water and the milk and Lansing water, and similar results, so far at least as the failure to detect any poison is concerned, were marked. Indeed, the chemical reactions were reached by only slight variations. The bacterial growths were much more abundant in the Iron Mountain water inoculations than in the others.

Nov. 16, seven days after the inoculations were made, four flasks, similar to those previously examined, were removed from the vegetation apparatus, and their contents were submitted to analyses similar to those already detailed.

The meat preparation inoculated with the Iron Mountain water was strongly alkaline in reaction and gave off a marked amine odor. After being acidified with hydrochloric acid, it was evaporated on the water-bath, the residue was extracted with absolute alcohol and filtered. The filtrate gave a precipitate with an alcoholic solution of mercuric chloride, but the precipitate proved readily soluble in slight excess of the precipitant. The mercury was removed by precipitation with hydrogen sulphide and filtration. The filtrate was evaporated on a water-bath, leaving a syrupy residue with some crystals of sodium chloride. The syrup was poured off from the crystals, taken up with water, and a portion of it (only a few drops of the syrup) was injected by means of a hypodermic syringe under the skin on the back of a cat. The temperature of the cat before the injection, taken with care and with a tested thermometer in the axilla, was 99.5°. The following is a record of the effect observed in the experiment:

Experiment 1.—Temperature before the injection, 99.5°

Time of injection, 3:14.

Temperature at 3:24, 100.25.

Temperature at 3:44, 101°. The cat drinks a large quantity of water, although she had an abundant supply of milk, which had been within her reach during the day and of which she had previousiy partaken. After drinking there is considerable retching, but no vomiting. The respirations are greatly accelerated and jerky. The pupils are dilated, but respond to light.

Temperature at 3:54, 101.8°.

Temperature at 4:19, 101.8°.

Temperature at 4:30, 101.5°.

The temperature was not again taken until the next morning, when it was found to be 99.5°. The animal seemed to have wholly recovered from any discomfort which it had suffered.

Experiment 2.—Two days later a similar amount of the syrupy residue was administered to the same cat in the same manner.

Temperature before the injection, 99.5°.

Time of injection, 4:30.

Temperature at 5:00, 102.0°.

The temperature was not taken again until next morning when it was found to be 99.5°.

Experiment 3.—A similar amount of the syrup was administered to another cat.

Temperature before the injection, 100°.
Time of injection, 3:33.
Temperature at 4:08, 101°.
Temperature at 4:33, 101°.
Temperature at 4:50, 101.6°.

Experiment 4.—Dec. 1. A much larger amount of the syrup than that used in the preceding experiments was injected under the skin on the back of a large Maltese cat.

Temperature before the injection, 99.5°.
Time of injection, 4:03 P. M.
Temperature at 4:19 P. M., 94°—marked salivation.
Temperature at 4:44 P. M., 98°--pupils are widely dilated. The cat vomits heavily and persistently.
Temperature at 5:30 P. M., 100°. The retching continues and a watery secretion flows from the mouth, nose and eyes.
Temperature at 6:00 P. M., 100°. Seems in a stupor.
Temperature at 8:00 A. M., Dec. 2, 103.4°. Stupor continues.
Temperature at 1:40 P. M., Dec. 2, 103.4°. When touched on the abdomen the animal cries as if in pain.
Temperature at 4:20 P. M., 104.1°. The animal seems much excited and dashed through the door of the room once, though she had previously been very quiet.
Temperature at 9:15 A. M., Dec. 3, 99.6°. Seems to be recovering, but still looks very haggard. Has eaten nothing since the injection.
Temperature at 1:40 P. M., Dec. 3, 100.8°. Eats some meat.
Temperature at 8:50 A. M., Dec. 4, 99.5°.

The cat was now killed with chloroform and careful examination made of the abdominal and thoracic organs. No abnormality could be found.

Experiment 5.—Some of the syrup obtained from the milk which was inoculated with Iron Mountain water was injected under the skin on the back of cat. The temperature in this case was taken in the rectum.

Temperature before the injection, 102.5°.
Time of the injection, 3:55 P. M., Dec. 9.
Temperature at 4:40 P. M., 97.6°.
Temerature at 5:25 P. M., 100.9°.
Temperature at 9:05 A. M., Dec. 10, 103.6°.
Temperature at 2:40 P. M., Dec. 10, 102.4°.

Both the meat preparation and the milk, which had been inoculated with the Lansing water, were carried through the same chemical processes to which the Iron Mountain preparation had been submitted, but they yielded only traces of the syrupy residue and these when injected into animals were without effect. These served as controls for the experiments already detailed and showed that there was nothing in the meat preparation or milk themselves which could cause the effects observed. As further control, however, the sterilized meat preparation which had been prepared as a control and which had remained in the vegetation trough for forty days at the temperature of the body without showing any bacterial growth was treated in the same manner that the other preparations had been, and the alcoholic residue was injected into animals without producing any effect.

Evidently the syrupy residue, which was used in the above experiments, contains a poisonous ptomaine, the special or characteristic production of

the micro-organisms present in the Iron Mountain water; and if these are the germs of typhoid fever, this syrup contains the special poison of typhoid fever. In the intestines of a man suffering from typhoid fever, the germs grow and constantly produce the ptomaine which is absorbed and causes the symptoms of the disease. If our extract contains the typhoid fever poison, we should expect it to produce, when employed as in the above experiment, in general the symptoms of the disease, but we should expect these symptoms to be temporary. We think that this is substantially what is shown by the experiments. The primary depression of temperature observed when the larger amounts were employed is certainly nothing more than might be expected from a large dose of a powerful poison; then the elevation of temperature which followed was in the majority of the experiments at least sufficiently marked. We did not expect to find in the animal examined the characteristic intestinal lesions of typhoid fever, as we suppose these to be due to the growth and activity of the micro-organism or to the local action of the ptomaine where it exists in larger amount, the place of its formation.

In 1885, Brieger [1] of Berlin, obtained from pure cultures of the Eberth bacillus, a ptomaine which in guinea-pigs produced a slight flow of saliva, frequency of respiration, dilatation of the pupils, profuse diarrhœa, paralysis and death within from twenty-four to forty-eight hours. Post mortem examination showed the heart in systole, the lungs hyperæmic, and the intestines contracted and pale. This substance Brieger considers the special poison of typhoid fever, and calls it typhotoxine, and it may be that we shall find that it forms the active principle of our syrupy residue. At present, however, the two do not seem to be identical. Brieger found no elevation of temperature, at least he does not refer to it, while the property of elevating the temperature seems to be the most characteristic effect of the Iron Mountain water poison. Typhotoxine produced profuse diarrhœa; while the other poison has shown no such effect. It may be remarked here that the fever at Iron Mountain has been characterized by the existence of constipation in the majority of the cases.

However, these differences in physiological action may be due to the fact that different animals were used, guinea pigs in one case, and cats in the other.

In 1880, Eberth[2] first described an oval bacillus, which he had found in the spleen and mesenteric glands of persons dead of typhoid fever, and which is now generally believed to be the true germ of this disease. Before Eberth, Koch had observed this germ and had taken micro-photographs of it. Even before Koch, Browicz[3], Sokoloff[4], Fischel[5] and others had individually observed, in the tissues of typhoid subjects, oval bacilli, which were probably identical with those of Eberth and Koch.

These bacilli are about one third as large as the red blood-corpuscles of man, and about three times as long as broad, though they may grow to long threads. The short rods have plainly rounded ends, and very active movements. They are affected by the amaline colors less than most germs, and are best stained by methylimblue. Whether or not this germ produces spores is a question of much interest to bacteriologists. Gafky[6] found that in po-

[1] Weitere Untersuchungen über Ptomaine.
[2] Virchow's Archiv, B. 81 and 83.
[3] Birch-Hirschfeld's Lehrbuch der pathologische Anatomie.
[4] Virchow's Archiv, B. 66.
[5] Prager Medicinische Wochenshrift, 1878.
[6] Mitheilungen aus d. Kais. Gesundheitsamte, B. 2.

tato, gelatine and blood serum cultures, kept at the temperature of the body, spores were formed. This observation has been confirmed by Sternberg,[1] Flügge und Bolton[2], Vilchour[3], and Chantemesse and Vidal[4]; though on the other hand, Buchner[5], Seitz[6], Michael[7], and Frankel and Simmonds[8] have, after numerous investigations, been unable to detect any spore-formation. This question is also of interest to sanitarians, since germ-spores resist disinfectants, which destroy germs growing without spores. Very recently Birch-Hirschfield[9] has apparently settled this question by detecting the spores by growing the bacillus in stained cultures. Another point of interest to sanitarians is the capability of this germ to resist high and low temperatures. Prudden[10] found them capable of growth after having been frozen in ice for 103 days and after having been heated to 56° C. This confirms the belief of sanitarians in this country that typhoid fever may be induced by the use of impure ice. The same investigation showed that frequent, alternate freezing and thawing did destroy the germ.

Still another point of interest is the fact that this germ will grow in various media. Seitz[11], and Wolfhügel and Riedel[12] found that it grew abundantly in milk. In our experiments, as has been seen, we obtained the poisonous extract from both the milk and meat cultures, though it was more abundant in the latter. It is worthy of note that the milk culture became acid in reaction, a fact which has also been observed by Löffler[13]. Seitz found that while the bacillus grew in both acid and alkaline urine, its growth was more abundant in the latter. However, it is probably of no sanitary importance whether the germ be taken into the stomach in milk or in water, for, in either case, on reaching the small intestine, it will find an alkaline medium in which to multiply. Wolfhügel and Riedel found that the bacillus multiplied in water which had been boiled, when kept at 16° C. Balton found the "spores" in stagnant water a month and longer after the introduction of the germ. Hochstetter[14] found the germ in artificial seltzer water a week after its introduction. Seitz found that quinine, kairin, antipyrine, thalline, salicylic acid and calomel in certain proportions arrest the growth of the germ in cultures, but that naphthalline, which seems to be a useful intestinal disinfectant in some diseases, is without effect upon the typhoid bacillus.

Upon potatoes, the typhoid bacillus shows a characteristic growth. It forms a mould wholly invisible to the unaided eye. After three or four days, if kept at ordinary temperature, after two days if kept at the temperature of the body, the surface of the potato looks moist, but no other change is observable. If the surface be scraped with a sterilized needle and the material thus obtained be examined under a sufficient power, it will be found to consist of active, moving typhoid bacilli. By making potato cultures, this bacillus can be distinguished from all known germs. Indeed, the best bacteriologists regard the potato culture as the crucial test for the

[1] Medical News, April, 1887.
[2] Zeitschrift für Hygiene, B. 1.
[3] Lancet, 1886.
[4] Archives de Physiologie. 1887.
[5] Archiv für Hygiene, B. 3.
[6] Bacteriologische Studien zür Typhusätiologie, 1886.
[7] Fortschritte der Medicine, 1886.
[8] Du ätiologische Bedeutung des Typhusbacillus, 1886.
[9] Archiv für Hygiene, B. 7.
[10] Medical Record, 1887.
[11] L. C.
[12] Arbeiten aus dem Kais. Gesundheits amte, B. 1.
[13] Berliner klinische wochenschrift, 1887.
[14] Centralblatt für Bakteriologie und Parasitenkunde, B. 1.

typhoid bacillus, and this test must always be made before one can be certain that he has this germ.

That the Iron Mountain water contained the typhoid bacillus was demonstrated by the potato culture and by microscopical examination, as well as by a physiological experiment. The first cultures were made as has been stated, Nov. 9, about two weeks after the water had been received. These cultures contained, besides the typhoid bacillus, germs ordinarily found in water; but the second cultures, made Dec. 7, contained only the typhoid bacillus. These had either destroyed or outlived the non-pathogenic organisms. This is an interesting fact, since it shows the poisonous germ to be very tenacious of life. Moreover, this observation is at variance with that of Kraus,[1] who found that the ordinary water bacteria destroyed the typhoid bacillus, though this difference may be due to the different temperatures at which the water was kept. Kraus kept the water in his experiment at 10½° C., while the Iron Mountain water was kept in a jug, in a basement room, the temperature of which was about 20° C.

In the meat peptone preparation the bacillus formed a scum, which had the lustre of mother of pearl and was bluish-gray, becoming slightly brownish after some weeks. Some of this growth was removed with a sterilized rod, rubbed up with 2 c. c. of water, which had been boiled, taken into a large, sterilized hypodermic syringe and injected into the abdominal cavity of a cat. Before the injection the hair was cut from the abdomen at the place of injection, and the skin was washed first with absolute alcohol and then with a one-half per cent solution of mercuric chloride. The injection was made at 2:25 P. M., Dec. 20. The temperature of the cat, taken in the rectum, before the injection was 101.5°. Twenty minutes after the injection, there was a fecal movement, and a few moments later, the animal vomited. The vomiting was repeated four or five times during the afternoon. When not vomiting or attempting to do so, the animal seemed greatly prostrated. She rested on her abdomen with her chin upon the floor and could not be easily aroused. She made several attempts at stool, but there was no purging or diarrhœa.

Dec. 21, 7:45 A. M.—The cat still lies in the same position. She refuses food. The temperature in the rectum is 96.4°.

2:30 P. M.—Cat still lies upon the floor and refuses milk. Temperature, 98.5°.

4:20 P. M.—Temperature, 101.4°.

5:30 P. M.—Temperature, 101.8°.

Dec. 22, 8:00 A. M.—Cat seems some better, but refuses food, and is very weak. She is unable to cry aloud; temperature, 103°.

2:30 P. M.—Takes some milk; temperature, 104°.

4:20 P. M.—Temperature, 104.4°.

Dec. 23.—The cat seems to be recovering rapidly. She takes food greedily and the temperature is normal.

The animal was then killed with chloroform. There was nothing abnormal at the point of injection. Nothing abnormal could be found in the peritoneal cavity. No trace of the small masses of injected bacilli could be found. The mucous membrane of the small intestines was slightly hyperæmic and in the region of Peyer's glands were observed four little ulcerations about the size of a pin head. Two or three similar ones were found in

[1] Archiv für hygiene, B. 6.

the ascending colon, but one of these was about four times as large as those in the small intestines, and around this was quite an area marked by inflammatory action. Careful inspection of all the abdominal and thoracic organs failed to reveal any further abnormality.

This result was very satisfactory, and leaves no room for doubt concerning the existence of the specific poison of typhoid fever in the Iron Mountain water.

It is to be noted that the lower animals are not subject to long-continued typhoid fever as is man, and a temporary effect from which the animal would within a few days die or recover is all that can be expected. Besides, the lessons in our experiment were certainly satisfactory. We hope to repeat this experiment several times.

It will be interesting to know something about the sanitary condition of Iron Mountain. For our information upon this point we are wholly indebted to Drs. J. A. Crowell and G. B. Johnson, physicians to the Chapin mine, who have been kind enough to answer our numerous inquiries.

Iron Mountain is a village with a permanent population of about 4,800, and during the summer months this number is augmented by some 2,000 floating population. As there are only about 1,000 buildings all told, and as some of the dwellings are very small, the village is very much crowded. The village is situated in a valley, the lowest portion of which was once a swamp, extending north and south. Upon each side the hills are steep and portions of the village lie upon these hillsides. The soil is drift of sand and gravel except in the lowest portions of the valley, where the drift is overlaid with vegetable mould. The depth of the drift is very variable. In some places the ledge of rock, which is of the Huronian strata, outcrops on the hilltops, in others on the hillsides, and in others in the valley. The ledge stands nearly on edge, dipping at from 70° to 80° to the north. The drift is so porous that within twenty-four hours after heavy rains the surface becomes dry.

A portion of the village, about 300 houses, has a system of water-supply, the source of which is a shaft 40 feet deep and far away from any source of contamination. An analysis of this water by Messrs. Brewster and Brown, chemists to the Chapin mine, shows the following:

Free ammonia, parts per million	0.02
Albuminoid ammonia, parts per million	0.05
Chlorine, grains per gallon	0.4
Calcium carbonate, grains per gallon	10.476
Magnesium carbonate, grains per gallon	5.324

Dr. Crowell writes: "Those drinking this water have been almost wholly exempt from the fever, and yet there have been some remarkable exceptions, a whole family coming down, while all neighbors were free from any sickness, and all drinking of this water."

The remaining portion of the village, the part in which the fever prevailed, derives its drinking water from wells sunk from six to twenty feet. There are no sewers or other means of removing filth. Privy vaults are used, and slops and garbage are thrown out in back yards and streets. During the past summer, a most disagreeable odor of decomposing matter greeted one in passing along the street. There is a ditch running through the village, which conveys the water from the mine to a small lake beyond

the village. This ditch, quite naturally, is used by many as an open sewer, and the ice supplied the village last summer was taken from this small lake into which the ditch empties.

Dr. Johnson writes that the outbreak of typhoid fever appeared early in August, following a severe epidemic of dysentery. Up to Dec. 21, he knew of 350 cases, about ten per cent of which had terminated fatally. The later cases, however, are much more malignant than those which occurred during the summer and early fall. Persons have presented themselves daily at the office for a week, complaining of pain in head, chest and back, loss of appetite and distressing feeling of languor, but have shown no elevation of temperature; then, within twenty-four hours, the temperature will be up to 104° or 105°. Diarrhœa was not present in the majority of the cases; indeed, constipation was more frequently the source of trouble.

The well (known as the Davis well) from which the water was taken which was sent to us, is sixteen feet deep. It is situated under the house and is forty feet from the stables and privy. Thirteen of the inmates of the house had the fever. (The doctors have failed to inform us of the total number occupying the house or using the water.)

An analysis of the water by Messrs. Brewster and Brown shows the following:

Free ammonia, parts per million, 2.27.

Albuminoid ammonia, parts per million, 0.26.

Chlorine, grains per gallon, 8.00.

These figures give unquestionable proof that the water is contaminated with animal excretions.

Manning's well, situated just across the street from the Davis well, is a drive well, carried down into the rock, and furnishes a fairly good water, notwithstanding the fact that surroundings are bad. Brewster and Brown give the following results of their analysis of this water:

Free ammonia, parts per million, 0.017.

Albuminoid ammonia, parts per million, 0.070.

Chlorine, grains per gallon, 0.050.

Dr. Crowell informs us that it has been decided to supply the village with water from some springs, the analysis of which show the following figures:

Free ammonia, parts per million, 0.032.

Albuminoid ammonia, parts per million, 0.039.

Chlorine, grains per gallon, 0.10.

Calcium carbonate, grains per gallon, 5.090.

Magnesium carbonate, grains per gallon, 3.558.

There can be no question about the need of a supply of pure water. This should by all means be obtained, and some provision should be made for disposing of excrement, slops and garbage. It matters not how cold it may be this winter, the low temperature will not destroy the typhoid germ unless there be successions of freezing and thawing. And with the soil filled with these germs some of them will be likely to find their way into the air breathed, food eaten or water drank, and produce the disease. It should also be remembered that typhoid fever may be caused by the use of impure ice.

Since writing the above, Dr. Crowell has furnished us with some additional facts of interest. "The fever was brought to the village by a man from a railroad construction camp. This man died a few days after his arrival. The symptoms were very variable. In some they were typical from

beginning to end, but in others they were very irregular. Constipation for the first ten days and frequently throughout the whole course of the disease existed in half the cases; and the abdominal symptoms, pain, tenderness, tympanitis, gurgling in the right iliac fossa, although certainly present in many cases, were conspicuously absent in a very large number. Intestinal hemorrhage occurred quite frequently and was the cause of death in one case in which we could never find any elevation of temperature. A subnormal temperature was very frequently observed, not only in the start, but throughout the disease. Failure of heart power, perforation, hemorrhage, pneumonia and meningitis, in the order named, were the causes of death. In only one case could we get an autopsy. It was one in which the symptoms were least like typhoid. The temperature was low, and there were no abdominal symptoms and no diarrhœa; yet the ilium was darkly congested, there were ulcerations of Peyer's patches, and, although no perforation could be seen, when the gut was inflated, it slowly collapsed."

In conclusion, we may state that there cannot be any doubt that the epidemic at Iron Mountain is one of genuine typhoid fever. The intestinal lesions were observed in the one post mortem. Similar lesions were found in the cat, the specific germ of typhoid fever exists in the water, and the chemical poison, or ptomaine, is formed by the growth of this germ.

It is well known that typhoid fever invariably follows dry seasons, and is coincident with low water in wells (see paper by the Secretary of the Michigan State Board of Health. Report for 1884, pp. 89–114.) There are, on an average, about one thousand deaths and ten thousand cases of sickness from this disease annually in Michigan. These figures can be greatly reduced if people will cease polluting the soil about their houses with slops, garbage, cesspools and privy vaults, and will see to it that their drinking water is pure beyond all question. When there is any doubt the water should be boiled, but it should be remembered that, while the typhoid germ most frequently finds its way into the body with the drinking water, it may be taken in with any food, and even with the air. When a case of typhoid fever occurs, all discharges should be thoroughly disinfected, and the earth, water and air about our homes must be pure, if we escape this disease altogether.

FOUR CASES OF POISONING FROM TYROTOXICON, WITH THREE FATAL RESULTS.*

INVESTIGATIONS AS TO THE ORIGIN OF THE POISON; RESULTS OF THE AUTOPSY AND CHEMICAL ANALYSES.

BY VICTOR C. VAUGHAN, M. D., PH. D.

September 23, 1887, I was visited by Dr. A. G. Mesic, of Milan, Michigan, who informed me that he had four members of a family under his charge, all of whom were seriously ill with peculiar symptoms, which he believed to be caused by tyrotoxicon. Since Dr. Mesic has written out for me the history of these cases, I will insert his report in full, as follows:

"Saturday, September 17, while passing the residence of S. H. Evans, a respectable farmer, I was called in to see him. I found him—a man of about fifty years, spare and muscular—vomiting severely, with flushed face, but with a temperature of 96° F. There was marked throbbing of the abdominal aorta; the tongue had a white, heavy coating, and the breathing was very labored. I set to work with the ordinary remedies to allay the vomiting, which had already continued for some hours. The vomited matters were colored with bile. Pupils were dilated, and a rash resembling that of scarlatina, but coarser, covered the chest, forearms, and legs below the knees, while the abdomen and thighs remained unaffected. As the bowels had not been moved since the beginning of the attack, I administered a purgative dose of calomel with a little podophyllin and rhubarb. On Sunday a small stool resulted. During that day and night, and the following day, the retching and vomiting continued. Small doses of carbolic acid seemed to give the most relief. After the movement of the bowels the symptoms were somewhat more promising; but a heavy and unfavorable stupor was observable and persistent.

"On Sunday the coating of the tongue remained very thick, and had changed to a dark brown color. At first I thought that his symptoms indicated a depressed condition, which I had known in one instance to precede typhoid fever. However, after a few days, I concluded that I must look for the cause of the condition among the poisons; but I could think of no one

*These cases were reported verbally to the State Board of Health at its meeting Oct. 11, 1887, and an abstract of Dr. Vaughan's report was printed in the pamphlet proceedings of that meeting. A vote of thanks was tendered to Dr. Vaughan, and he was asked to prepare a full report for publication in the Annual Report. This paper was published in the Medical News of Dec. 3, 1887. It is part of the First Quarterly Report of Work in the Michigan State Laboratory of Hygiene at the State University. H. B. B., Sec. S. B. of H.

poison which would be likely to produce all the symptoms observed. During Monday, Tuesday, and Wednesday there was but little change, and the treatment was continued.

"On Thursday morning I found the son Arthur, a lad of eighteen years, strong and vigorous, suffering with the same symptoms, only in a more violent form. After supper on Wednesday evening, he was taken with nausea and vomiting. He had no rash, but the symptoms were otherwise identical with those of the father, except in being more severe. I gave a cathartic, which acted only slightly.

"At my evening visit I found Mrs. Evans, a lady of about forty-five, previously in good health, with the same symptoms. In this case the stupor was more marked from the first. I was unable at any time to obtain any cathartic action in this case. Copious enemata of warm water were used, but succeeded only in washing some hardened lumps from the rectum. By this time I had concluded that the poison was most likely tyrotoxicon.

"On Friday morning the only remaining member of the family at home, Miss Alma, sixteen years of age, was affected in the same way as the others. On that day I went to Ann Arbor, and gave a history of the cases so far to Dr. Vaughan, who, from the symptoms, thought that my diagnosis was most probably correct, and he advised with me as to treatment, which I carried out. I gave two grains of sodium salicylate every four hours, and used small doses of the tonics and stimulants, quinine, nux vomica, digitalis, whiskey, and the aromatic spirits of ammonia. On Saturday the symptoms in all remained unimproved, and in the mother and son the stupor and labored breathing grew more marked.

"On Sunday, I again went to Ann Arbor, and brought Dr. Vaughan with me to see the patients. The temperature of the mother on Sunday was as low as 94°, and that of the son 95°. Dr. Vaughan agreed with me as to diagnosis and treatment. Sunday evening the patients were all removed to the house of a neighbor, about forty rods distant (the reasons for this will be given later). Dr. Vaughan and I both expressed the fear that the mother, and possibly the son, would not live through the night. Both of these rapidly grew worse, and the son died at 7:45 A. M., and the mother at 4 P. M., Monday.

"During Monday the daughter rapidly grew worse, and at the time of her mother's death could not be aroused, and practically she remained unconscious from that time on. The father was very weak, but retained his consciousness all the time. Convulsive movements of the limbs had been noticed in the son, but not in the mother. These now became more marked in the daughter, who remained in the heavy stupor, with labored breathing, until 5 P. M. Thursday, when she died.

"Mr. Evans has slowly improved, and now, October 18, is able to walk about the room. The sodium salicylate, even in the small doses used, seemed to cause severe headache; so apparent was this that the drug was discontinued, and drop doses of amyl nitrite, given every hour, seemed to relieve the pain in the head. The father's temperature remained below the normal until Thursday, October 14, when it reached the normal. After this it was found once as high as 99.5°, then 99°, then again normal, where it remains.

"All complained of a burning constriction in the throat, and difficulty in swallowing, and all, as long as they were conscious, frequently called for ice.

In all the pulse was rapid and feeble, and death seemed to result from failure of the heart. Those who died voided urine involuntarily, while Mr. Evans passed small quantities frequently, and for this some buchu and uva ursa were given. During his convalescence some small doses of morphine were given to the father, as he was unable to sleep, and became very restless. He is now taking teaspoonful doses of the elixir of calisaya and iron every four hours."

As stated above by Dr. Mesic, I first saw these patients Sunday, September 25. On a sofa in the room we found the daughter, Alma. She had been vomiting during the day, and seemed much exhausted. She was not inclined to talk, and seemed to be in a stupor, though when spoken to, she responded rationally. Her pupils were slightly dilated, her tongue coated, her pulse 120 and weak, her face flushed, and a violent throbbing could be felt over the abdomen, which was retracted. Her temperature was 96°.

In another room were the father, mother, and son, two of them dying. The father was rational, and talked with some freedom when I asked as to the kind of food they had been eating, etc. His pupils were normal. His face could not be said to present any peculiar feature. His pulse was rapid, breathing somewhat labored, and the throbbing of the abdominal aorta was plainly felt. The abdomen was retracted, and there was no pain on pressure. He complained of a burning constriction of the throat, swallowed with difficulty, and said that his throat and stomach felt as though they were on fire.

The mother lay perfectly still with eyelids closed, as if in a deep sleep. Her pulse was rapid, her face had a livid flush, her breathing was about 35 per minute, and labored. The skin was cool, but neither abnormally moist nor specially dry and harsh. She could not be aroused. In fact, she was comatose.

The son rolled uneasily from one side of the bed to the other. His breathing, also, was very labored. His eyelids were closed, and the pupils were markedly dilated—did not respond to light. He could not be aroused. In mother and son, as well as in father and daughter, the abdomen was retracted, and the throbbing of the abdominal aorta was easily felt.

Now, to what were these symptoms due? They were certainly those of some poison. Dr. Mesic had brought me some of the vomited matter, which I tested thoroughly for mineral poisons, with negative results. The symptoms certainly were not those of morphine, strychnine, digitalis, or aconite. They did have some resemblance to those of belladonna, but yet they were not the symptoms of belladonna. The pupils were not as widely dilated as they would be in belladonna poisoning. There was in none of these persons the active delirium of belladonna poisoning. There was no picking at the clothing, no grasping of imaginary objects in the air, no hallucinations of vision. Surely it could not be any vegetable alkaloid with which I was familiar.

On the other hand, we know that nausea, vomiting, headache, dilatation of the pupil, rapid pulse, heavy breathing, constipation, and great prostration, with stupor, do occur in cases of poisoning with certain ptomaines. Therefore, we began to look for conditions which would be favorable for the production of putrefactive alkaloids. These conditions we were not long in finding.

The family, which consisted of the four persons sick, and of a daughter,

about twenty years of age, who was away from home at the time when the others were taken ill, and for some months before that time, was evidently a tidy one. This was shown by their personal appearance, and by the clothing and bedding. But the house in which they lived was very old and very much decayed. Mr. Evans had purchased the farm six years ago, and for some three years past, at least, they had been troubled every now and then, one or more of the family, with nausea and vomiting, followed by more or less prostration. But in no instance, up to the present illness, had the symptoms been sufficient to cause them to summon a physician. The family had worked hard in order to pay for the farm, and had determined to make the old house do until they were out of debt. Even before this family had moved to the farm, the house had been known among the neighbors as an unhealthy one, and there had been much sickness and a number of deaths among its former tenants.

The house is a frame one, and one of the neighbors said to me that it was an old house when he came to the neighborhood thirty-seven years ago. It consists of two rooms on the ground-floor, with attic rooms above. The frame rests upon four large logs or sills, which lay directly upon the ground, and are thoroughly rotten. There is no cellar under any part of the house. From the front, at least, the surface slopes toward the house, and the rain water runs under it. In the floor of one room a trap door had been placed, and directly under this a small excavation had been made for the purpose of collecting the rain water when it accumulated under the house. Although this pit was dry at the time of our examination, its sides and bottom were marked with cray-fish holes, showing that water had stood in it. The floor was laid of unjointed boards, and every time that it was swept much of the filth fell through the cracks, and every time that the tidy housewife scoured and mopped the floor, the water, carrying with it the filth, ran through the crevices, and thus the conditions most favorable for putrefactive changes were brought into existence, and maintained.

One corner of one of the rooms had been transformed into a small room, or buttery, as it was called, and in this, on shelves, the food was kept. On account of the more frequent scouring demanded by that part of the floor enclosed in this buttery, the boards had rotted away, and a second layer of boards had been placed over the original floor. Between these two floors we found a great mass of moist, decomposing matter, the accumulations of years, which the broom could not reach. When this floor was taken up a peculiar, nauseating odor was observable, and was sufficient to produce nausea and vomiting in one of the persons engaged in the examination. Some of the dirt from beneath the floor, and some of that which had accumulated between the boards in the buttery was taken for further study.

The condition of the house was supposed to be unfavorable to the patients, and for this reason they were moved, as Dr. Mesic has stated, to the house of a neighbor. Of course, thorough examination of the house was not made until the patients had been removed.

Special inquiry was now made concerning the food used by this family. They had been living very simply. They lived upon bread, butter, milk, and potatoes, with coffee and ripe fruit. They had eaten no canned foods for months. They ate but little meat. Occasionally a chicken was killed and served, and rarely some fresh meat was obtained from the village. During the week in which they were taken ill, all the meat used consisted of

slices from a piece of bacon, the only meat which was kept in the house, and a chicken. None of the latter remained, but the bacon was examined. It seemed in perfect conditon and contained no trichinæ. Moreover, as has been seen from the history of the cases, all the members of the family were not made sick by any one meal, but the opportunity of obtaining the poison must have been present for some time. Moreover, the fact that previous similar, but less severe attacks had occurred at intervals for the past three years convinced us that the poison must owe its origin to some long existing condition.

The drinking water supply was also investigated. The water was obtained from a shallow well, and some of it was taken for analysis. But several families had for years used water from this well, and had remained healthy.

The milk used by the family was studied. Of course, we could get none of that which had been used before the members of the family were stricken down. As soon as he made the diagnosis of tyrotoxicon poisoning, Dr. Mesic ordered the discontinuance of the use of milk, not only with the sick, but he forbade the daughter, who had returned, and any of the visitors using it. Mr. Evans owned four milch cows and they were supplied with fair pasturage and abundant water. The greater part of the milk was placed in tin cans, which were set in a wooden trough in the yard, and surrounded by cold water. The covers to the cans were arranged so that the air could have free access to the milk, and were left in this position until the milk was thoroughly cooled. Indeed, the cans were furnished by a creamery company, which followed the directions which I have previously given for the care of milk. On his first visit to me, Dr. Mesic brought some of the milk from one of these cans. This I examined, but failed to find tyrotoxicon in it.

However, the family did not drink any of the milk from the cans. That which they did use was kept in the buttery which I have described. Here it stood upon a shelf and some members of the family at least were in the habit of drinking from it between meals. This was especially true, it is said, of the son. He would frequently come from his work in the fields, go into the buttery and drink a glass or more of the milk. Mr. Evans states that he frequently observed that the taste of the milk was not pleasant. On my first visit to the premises, I advised that some milk should be taken from the cans, allowed to stand in the buttery over night and be sent to me the next day. This was done, and in this milk we found tyrotoxicon not only by the employment of chemical tests, but by poisoning a kitten with it.

On the death of the mother and son, Dr. Mesic asked for a post-mortem, but the friends objected, and the undertaker used an arsenical embalming fluid, so that, although consent was subsequently obtained, it was decided that the examination would be so vitiated as to be worthless. On the death of the daughter, Dr. O. C. Jenkins, the coroner, summoned a jury and held an inquest. The post-mortem was conducted by Dr. George A. Hendricks, in the presence of the jury and several physicians who had been invited. Dr. Hendricks has kindly furnished me with his report, which I present here in full:

The "autopsy was held fifteen hours after death. The abdominal viscera were first examined. The great omentum was small, in normal position, covering the small intestine. The small intestine was moderately distended with flatus. The jejunum was ashy-green in color; the ileum purplish-green. About eighteen inches from the termination of the ileum was found a diver-

ticulum two inches in length. The small intestine contained very little alimentary matter. The vermiform appendix was free, contained some small fecal lumps, and showed no evidence of any inflammation. The cæcum, ascending, transverse, and descending colon, were empty and their circular fibres were tightly constricted, except at intervals where the intestine was distended with gas. The sigmoid flexure was moderately distended with gas, and the rectum contained small bits of fecal matter. The stomach was somewhat contracted and lay wholly upon the left side of the median line. It contained a few ounces of fluid. Its extremities were ligated and the organ removed. The mucous membrane of the stomach and intestine were not examined until they reached the chemist. The duodenum was distended with flatus. The liver was normal in size and appearance. The gall-bladder contained about one ounce of bile. The spleen was normal. One-half ounce of fluid deeply stained with blood was found in Douglas' cul-de-sac. The uterus, Fallopian tubes, and ovaries were deeply congested. The left ovary was enlarged and presented on its posterior surface a hemorrhagic spot, oval, about one-half line in length, and several other less distinct ones. The right ovary was normal in size and showed numerous Graaffian scars. The ureters and bladder were normal; the latter contained a small amount of urine. The peritoneum, pancreas, and kidneys, were perfectly normal.

"The thoracic cavity was next opened. The lungs were normal; there was about one-half ounce of free serum in the left pleural cavity; none in the right. Pericardium normal; right auricle in diastole; left auricle and both ventricles in systole.

The dura mater showed venous congestion;" the arachnoid normal; the pia-mater congested. On the surface of the centrum ovale, small drops of blood oozed from the divided vessels. The large veins of the velum interpositum were distended. Third and fourth ventricles were slightly distended with serous fluid, but the walls were normal. There seemed to be slight softening of the optic thalami. The sub-arachnoid fluid was about twice the normal quantity.

On examination of the mucous membrane of the stomach and intestine in the presence of the chemist, Prof. A. B. Prescott, nothing abnormal could be found. The membrane was stained with bile, but there was not the slightest redness. The solitary glands were distinct but not at all inflamed. Peyer's patches were normal.

It will be seen that there existed no lesion which would account for the death. The venous congestion observed in the brain would follow from failure of the heart.

Some of the post-mortem appearances bore a striking resemblance to those which I had observed in cats poisoned with tyrotoxicon. This was especially noticeable in the condition of the mucous membrane of the stomach and intestine. Tyrotoxicon produces the symptoms of a gastro-intestinal irritant, but not the lesions. The contraction of thecircular fibres of the intestine, which undoubtedly caused the constipation, I had also observed in cats that died from tyrotoxicon poisoning without either vomiting or stool. The action of this poison upon the stomach and intestines must be through the nervous system. Small doses cause both vomiting and purging, while, afterlarge doses, vomiting may be impossible, and obstinate constipation may exist. Both the vomiting and purging after small doses are undoubtedly due in part to increased activity of the circular fibres of the muscular coats, induced

through the nerves; and the inability to vomit, and the constipation, one or both of which may be observed after large doses of the poison, are due to spasm of the same muscles, induced in the same manner.

Prof. A. B. Prescott was requested by Coroner Jenkins to analyze the material for mineral and vegetable poisons. He made analyses of the stomach and part of its contents, and a portion of the liver. His results were wholly negative.

Mr. F. G. Novy tested a cold-water extract of the finely divided intestine for ptomaines. The fluid, which was acid in reaction, was filtered, then neutralized with sodium bicarbonate, and shaken with ether. The ether, after separation, was removed and allowed to evaporate spontaneously. The residue was dissolved in water, and extracted again with ether. This ether residue gave the chemical reactions for tyrotoxicon, and a portion of it was administered to a kitten about two months old. Within half an hour after the administration the kitten began to retch, and soon it vomited. Within the next three hours it was noticed to vomit as many as five times. The breathing became rapid and labored. The animal sat with its head down, and seemed greatly prostrated. The pupils were examined, but could not be said to be dilated. There was no purging. The retching and heavy breathing, with evidences of prostration, continued more or less marked for two days, after which the animal slowly improved.

A quantity of fresh milk was divided into five portions of one quart each, placed in quart bottles which had been thoroughly cleansed, and treated in the following manner:

No. 1 consisted of the milk only, and was employed as a control test.

No. 2 was mixed with a drachm of vomited matter.

No. 3 was treated with a portion of the contents of the stomach.

No. 4 was treated with an aqueous extract of the intestine.

No. 5 was treated with a small portion of the soil, which had been taken from the floor of the buttery, stirred up with water.

These bottles were placed in an air-bath, and kept at a temperature of from 25° to 30° C. for twenty-four hours. Then each was tested for ptomaines. No. 1 yielded no tyrotoxicon, while all of the others contained this poison. The tests were both chemical and physiological. All of the samples yielded a non-poisonous base when treated according to Brieger's method, and the same substance was obtained from perfectly fresh milk. It is most probably formed by the action of the heat and reagents employed in this method. This base was obtained in crystalline form, and several portions of it were administered to kittens without any effect. The further study of this body will be of interest to toxicologists, because it gives many of the general alkaloidal reactions. At first we supposed it to be Brieger's neuridin, and this supposition may still be correct, but, as we obtained it, it gave some reactions which are not given by neuridin. Further investigagations will be made on this point.

Tyrotoxicon was obtained from the filtered milk by two methods: (1) The one which we have previously used, and which consists in neutralizing the filtered milk with sodium bicarbonate, and extracting with ether. That portion of the poison employed in the physiological tests was obtained in this way, and in order to be sure that no poison came from the ether, the extract from the milk to which nothing had been added was given to a kitten, and was found to produce no effect. (2) The filtrate firom the milk was heated

to 70° C. (158° F. (tyrotoxicon decomposes at 91° C.) (195.8° F.)) for some minutes, and filtered. This filtrate, which was perfectly clear, was treated with a small quantity of nitric acid in order to convert the tyrotoxicon into a nitrate, then pure potassium hydrate in the solid form was added until the solution was strongly alkaline. This solution was concentrated so far as it could be, on the water-bath. (The potassium compound of tyrotoxicon is not decomposed below 130° C. (234 F.)) The dark brown residue, after cooling, was examined with the microscope and found to contain the crystalline plates of tyrotoxicon-potassium hydrate, along with the prisms of potassium nitrate. The former was separated from the latter by extraction with absolute alcohol and filtration. The alcohol was evaporated to dryness on the water-bath, and the residue again extracted with absolute alcohol. From this alcoholic solution tyrotoxicon was precipitated with ether. The precipitate was decomposed by adding acetic acid and heating, the tyrotoxicon being broken up into nitrogen and phenol. The phenol was recognized by precipitation with bromine water, and by other well-known tests.

On October 8th, the coroner's inquest, which had been adjourned after the *post-mortem*, in order to await the results of the analysis, was resumed, and after hearing the testimony in accordance with the above stated facts, the jury returned a verdict of death from poisoning with tyrotoxicon.

Ehrhart has recently published the history of some cases of poisoning from cheese, of which the following is an abstract: The family of a workman, consisting of eight persons, ate for supper 600 grammes (about 18 ounces) of Limburger cheese. The rind was covered with a heavy mould, while the interior had become fluid from putrefaction, and was of bitter taste. Three ate only of the mouldy rind, and these remained well. The next morning, the five who had eaten of the inner portion suffered from vertigo, nausea, vomiting, and abdominal pains; no stool. The father had convulsive movements of all the extremities. The pupils were dilated, and did not respond to light; there were double vision, cold sweat, skin cynanotic, abdomen distended, difficulty in swallowing, delirium, mild trismus, and temperature 40° C. (104° F.). The temperature of the mother, on account of the great collapse, was sub-normal. She had no convulsive movements, but there was prolonged loss of consciousness. The pulse was small and thready, and threatened paralysis of the heart. Recovery was very slow. The others suffered only from gastro-enteric symptoms. Ehrhart discussed the question as to whether these symptoms were due to tyrotoxicon, or to infection with micro-organisms; but as I have not had access to his original paper, I do not know what his conclusions are. (*Schmidt's Jahrbücher*, B. 213, S. 248.) However, there cannot be much doubt that in those cases in which the organism is taken into the alimentary canal, it continues the elaboration of its poisonous products.

There is one other point to which I will only refer at this time. It seems now that small doses of tyrotoxicon, especially when repeated, elevate the temperature. This is probably due to peripheral irritation, which is a common cause of elevation of temperature. On the other hand, fatal doses cause depression of temperature from collapse.

EXPOSURE OF THE STENOCARPINE FRAUD.*

BY F. G. NOVY, M. S.

In a paper published in the New York Medical Record, July 30, 1887, Dr. J. H. Claiborne, Jr., called attention to a new local anæsthetic which was said to have been obtained by Doctors Goodman and Seward from the leaves of a tree growing in Louisiana. Strange to say, neither of the two discoverers were able to name the tree which yielded this new alkaloid. Nevertheless, in order that the new base might not go unnamed, Dr. Seward dubbed it Stenocarpine, because of the likeness the tree bore to Acacia stenocarpa. This comparison was, as Dr. Hoffman at once remarked (RUNDSCHAU, Sept. 1887, p. 214), very suspicious, since A. stenocarpa is not an American plant, but is a native of Central Africa.

Dr. Claiborne's paper, detailing some experiments with this new alkaloid, was followed by another in the same journal (Aug. 13), from no less an authority than Prof. Knapp, of New York, who made some physiological experiments with the same substance. He arrived at the conclusion "that the new local anæsthetic is very similar to cocaine, chiefly differing from it by its more powerful and lasting mydriatic property." In a still more recent article Dr. Claiborne (Med. Record, Oct. 1), announced the source of the new alkaloid to be the Gleditschia triacanthos, Linn., also at first indicated by Dr. Hoffman. Another peculiar thing was, that neither Goodman nor Seward had in their possession any specimen of the leaves from which they had extracted their alkaloid. At Dr. Claiborne's request Mr. Goodman wrote to Louisiana for some of the leaves. After some delay, a batch of leaves was received which did not appear to be identical with those from which the anæsthetic principle had been obtained. Accordingly more explicit directions were sent, and this time the genuine leaves were received and identified as those of Gleditschia. The reason which they assigned for not having any of the leaves in their possession was that they had reduced the active principle on the banks of the Mississippi, and then brought it to New York.

It is pertinent to observe at this point that no communication has been made as to the chemical properties of this new substance, although Dr. Seward is reported as having analyzed the leaves and isolated from them the

*A paper similar to this, but having a different title, was published in the Pharmaceutische Rundschau, for November, 1887.

The solution of which this report treats, consisted of a mixture which contained a dangerous quantity of cocaine, and was advertised as a perfectly safe preparation from the honey locust. It was treated of popularly by the newspapers before its exposure, and all classes were more or less interested in it. The exposure was so complete that the preparation was driven from the market. If the purity of medicine is of value to public health, certainly this exposure is.

active principle, which was found to be an alkaloid. Beyond this mere mention, and the statement made by Mr. Goodman that "the new alkaloid is not, strictly speaking, a powder, but a semi-liquid mass, of a greenish tint," no further communications can be found. Inasmuch as the salt was said not to be permanent, a two per cent solution was recommended. An ounce of this solution cost $6.00, which would give sixty cents as the cost per grain. It is, therefore, all the more surprising that such well-informed and experienced physicians as Dr. Knapp and Dr. Claiborne should give full credence, without stopping to ask for positive proofs, as to the individuality and genuineness of this substance.

At the request of Messrs. Lehn and Fink I examined what was labeled as a "two per cent solution of the so-called Gleditschine or Stenocarpine," and the results obtained deserve the attention of all those interested in "new and wonderful remedies."

The solution was light yellow in color, acid in reaction, and possessed a sweetish odor, strongly resembling that of liquorice.

An examination for inorganic acids showed the presence of hydrochloric acid and a small quantity of sulphuric acid.

A definite quantity of the liquid was acidulated with hydrochloric acid and extracted with ether. The residue obtained on evaporation of the ether was colorless and crystalline and corresponded to 0.31 per cent. It possessed a strong "Fine-cut" like odor and was found to be Salicylic acid. Fe_2Cl_6 and $PtCl_4$ gave the characteristic pink to violet color with solutions of the residue. It may be well to remark here that the latter reagent, $PtCl_4$, is equally as good as Fe_2Cl_6 in testing for salicylic acid. The color reaction in both cases is almost identical.

The acid aqueous solution containing the alkaloid was now rendered alkaline with NH_4OH, and again extracted with ether. The addition of the alkali produced a heavy white precipitate which dissolved readily in ether. The clear ether solution on spontaneous evaporation left a colorless crystalline residue possessing the characteristic odor of cocaine. It gave an alkaline reaction with moist litmus paper. The solution of its hydrochloride gave with ordinary and with alkaloidal reagents reactions identical with those of cocaine. The free alkaloid, when recrystallizing in a glass dish, formed at first a colorless syrup, which gradually became crystalline. Cocaine very often shows the same behavior. The syrup as well as the crystals possessed a bitter taste, and produced a strong flow of saliva and a benumbing effect on the tongue. The crystals melted at 89° C.

A small portion of the alkaloid was heated with a few drops of nitric acid for a few minutes and then gently evaporated to dryness. The cold residue touched with a few drops of alcoholic solution of KOH developed a beautiful violet color, and at the same time a strong odor of methyl benzoic esther. This color reaction is characteristic of the atropine group of alkaloids. It is well to note at this point that, when cocaine is treated in the same manner, no color reaction is obtained, but the characteristic odor of benzoic esther (similar to Oil of Wintergreen) is always produced on the final treatment with alcoholic solution of potash. Minute quantities of cocaine can thus be distinctly recognized. As a qualitative test for the presence of cocaine, it is perhaps the best that I am acquainted with.

Whilst speaking of cocaine, I desire to make note of the observation, numerous statements to the contrary, that chloroform does not readily extract

cocaine from alkaline solutions. In fact I have been unable, even on prolonged agitation with chloroform, to remove the precipitate of cocaine produced by addition of NH_4OH to solutions of its salts.

Two determinations were made of the amount of the free alkaloids present in the "*Gleditschine*"-solution. This was found to be 5.81 and 5.87 per cent.

The specimen, it will be remembered, was labeled as a 2 per cent solution of Gleditschine.

On the label, the formula $C_{20}H_{21}NO_3$ was ascribed to this new alkaloid. In order to more fully confirm the results given above, and at the same time to see what truth, if any, lay in the formula assigned, the alkaloidal residue was recrystallized several times from alcohol and from ether, and then subjected to ultimate analysis. The platinochloride was also made and the per cent of platinum determined. In the following table the results obtained are compared with the theoretical percentages calculated for cocaine, for atropine, and for "Gleditschine," $C_{20}H_{21}NO_3$.

	%C.	%H.	%Pt.
Found in the base extracted from the so-called Gleditschine solution	67.84	7.23	19.41
Calculated per cent:			
in Cocaine ($C_{17}H_{21}NO_4$)	67.33	6.93	19.14
in Atropine ($C_{17}H_{23}NO_3$)	70.06	7.96	19.70
in $C_{20}H_{21}NO_3$	74.30	6.50	18.43

The above results confirm most decidedly the conclusion already arrived at—namely, that the so-called Gleditschine or Stenocarpine is nothing but a mixture of cocaine and atropine.

In order to ascertain the amount of atropine present in the solution, the amount of H_2SO_4 was determined and found to be 0.073 per cent. This amount, calculated as atropine sulphate, gives 0.50 per cent of the latter salt. The per cent of atropine thus obtained was subtracted from the per cent of total alkaloids and the difference calculated as cocaine hydrochloride. This was found to correspond to 6.03 per cent.

The so-called Gleditschine or Stenocarpine consists, therefore, essentially of 6.00 per cent of Cocaine hydrochloride, 0.50 per cent of Atropine sulphate, and about a third of a per cent of Salicylic acid. The latter is used as a preservative.

Immediately after making my analysis of the solution of "Gleditschine," as reported above, I obtained two pounds of the perfectly fresh leaves from a hedge growing in Ann Arbor, and which Prof. Spaulding of the Chair of Botany pointed out to me as being Gleditschia triacanthos. These two pounds were subjected to chemical analysis. The leaves were thoroughly crushed in an iron mortar, then repeatedly extracted with a dilute alcohol 5 per cent solution of sulphuric acid. The concentrated percolate thus obtained was evaporated at a low temperature to drive off the alcohol. The aqueous solution was then filtered and the filtrate, after being made alkaline with ammonia, was thoroughly extracted with ether. The ether solution was agitated with a dilute aqueous solution of hydrochloric acid for the purpose of forming hydrochlorides of any alkaloids that might be present in the ether solution. The acid aqueous solution was now made alkaline with ammonia and extracted with ether. The ethereal solution on spontaneous evaporation left behind a scarcely perceptible residue which contained some

ammonium chloride. Applied to the clean mucous membrane it produced no anæsthetic effect whatever, though it seemed to me that a slight aconite like tingling was felt. The residue, dissolved in a few drops of dilute hydrochloric acid, gave the following reactions:

Iodine in potassium iodide, a brown precipitate much darker than that produced by either cocaine or the "Gleditschine" solution.

Picric acid, an abundant yellowish white precipitate.

Mayer's Reagent, a white precipitate.

Phospho-molybdic acid, a heavy white flocculent precipitate.

The remainder of the hydrochloric acid solution was evaporated to dryness on a water-bath, treated with a few drops of nitric acid and again evaporated to dryness. A drop of alcoholic potash added to the residue produced neither coloration nor any odor. This same test applied to the alkaloids from the "Gleditschine" solution gave a beautiful violet color and a strong odor of methyl benzoic esther.

These results then show that the leaves of Gleditschia triacanthos do not contain the alkaloid which they were reported to contain. Traces of an alkaloid were, however, found to be present, and these gave reactions different from the alkaloid of the "Gleditschine" solution. It will be well to add that the leaves of this tree have been examined a short time ago by B. H. Paul and A. J. Cownley (Pharm. Journ. and Trans. Oct. 15, p. 317); by Mr. Thompson of Parke, Davis & Co. (Medical Age, Oct. 25, p. 466) and by Prof. Karl Mohr of Mobile (Pharm. Rundschau, Nov. 1, p. 250), all of whom have obtained negative results.

Hygienic Laboratory, University of Michigan,
Ann Arbor, Nov. 9, 1887.

DANGERS IN GASOLINE.

BY JOHN H. KELLOGG, M. D., MEMBER OF THE STATE BOARD OF HEALTH, BATTLE CREEK.

Mr. Chairman, Members of the State Board of Health:—

As your committee on the preparation of a circular calling attention to the dangers connected with the domestic use of gasoline, I would respectfully submit the following:

The extensive introduction of gasoline stoves within the last few years has brought into very general domestic use an article, the presence of which in a dwelling house is a constant menace to life and property. Gasoline, since its discovery, has always been known to chemists to be a dangerous substance. It evaporates rapidly at ordinary temperatures, and its vapor, when mixed with ordinary air, in proper proportion, forms an explosive compound the same as does ordinary illuminating gas. It is stated that one pint of gasoline, when evaporated, will render explosive two hundred cubic feet of air. The vapor of gasoline is in some respects more dangerous than common illuminating gas, especially the variety of gasoline which is ordinarily used in connection with gasoline stoves.

1. Because it is somewhat heavier than the air instead of lighter, as is the case with illuminating gas. On this account, it accumulates in greatest quantity near the floor, and thus its presence is not so quickly detected, and it more readily comes in contact with fire in grates or stoves, and it does not so readily find an outlet through open windows, the ordinary means of ventilation.

2. The gasoline recommended by the manufacturers of gasoline stoves, and ordinarily employed in their use, having been deprived to a great degree of its characteristic odor, is much less readily detected in the air of a room than the same quantity of illuminating gas.

3. Illuminating gas is suffocative in its effects, as well as extremely unpleasant in odor, so that its presence becomes unbearable long before the proportion present in the air of a room becomes so great as to render it explosive.

Several years ago this Board called attention to the dangers of using explosive kerosene oil; and protective legislation has been maintained which has doubtless been the means of saving many lives. Before the enactment of the laws referred to, loss of life and serious injuries from kerosene explosions were exceedingly frequent, but at the present time, casualties from this cause in

Michigan are almost unknown. This safety in the use of kerosene oil has been secured by the more perfect separation from it of the explosive products of coal oil. Gasoline is one of the most explosive substances obtainable from coal oil, and it is not to be wondered at that the extensive use of this dangerous article of late years has led to frequent distressing accidents, usually involving grave personal injury and often loss of life. The increasing frequency of these accidents has led this Board to undertake an inquiry into the matter, the results of which are, in part, embodied in this circular.

A letter was addressed to each of the leading manufacturers of gasoline stoves, asking for descriptive circulars and directions for the use and care of a gasoline stove. A careful examination of these circulars failed to discover any proper warning respecting its safe keeping or handling. Indeed, the evident effort of manufacturers and dealers is to convince the public that the use of gasoline is *perfectly safe*, although it is well enough known to every one familiar with its properties that a mixture of the vapor of gasoline with common air in proper proportions is as violently explosive as gunpowder and many other explosive substances. It is true that gasoline may be handled in such a manner that the risk of explosion and consequent injury may be made very small. The same is true, however, of gunpowder, nitro-glycerine, and dynamite. But these substances not infrequently explode with most destructive violence, even in the hands of those who are educated respecting their character, and trained in their use. This fact restricts the handling of the explosives mentioned to very few persons, and their employment to those uses for which no other substances can be well substituted. Certainly no one would think of placing gunpowder or nitro-glycerine in the hands of ignorant or unskilled persons, even though precise instructions respecting their use might accompany the destructive articles; yet this is precisely what is being done in the most extensive manner with gasoline, an explosive in all respects more dangerous than gunpowder. Gunpowder will not explode unless fire is brought in immediate contact with it. It certainly will not leave the can containing it, should the cover happen to be left off, and insidiously find its way to a fire, a lighted lamp, or other means by which an explosion may be produced. But this may occur with gasoline. Notwithstanding these well known facts, thousands of gasoline stoves and the gasoline employed in them are to-day in the hands of ignorant persons, many of whom are perhaps ignorant of the explosive nature of the vapor of gasoline, and who at least seldom appreciate the extent of the danger to which they and other persons are exposed in its use.

A circular letter addressed to the officers and general agents of the leading insurance companies doing business in this country elicited a large number of replies, the writers of which, with barely two exceptions, pronounce the domestic use of gasoline as a fuel extremely dangerous, and greatly deplore the general introduction of gasoline stoves, not only on account of the increased risk to property, but of the great risk of serious personal injury or loss of life. Although not requested to withhold the names of the writers of these letters, we quote without credit, for brevity's sake, the following opinions and statements from the great number of letters received.

A general insurance agent writes:

"I have known of at least twenty-five cases in which the use of gasoline stoves caused a loss of life and injury, and from my experience of them I would not have one in my house under any circumstances, as in my judgment *they cannot be made safe.*"

A general agent doing business in Detroit states, under date of Nov. 15: "On the first of July I commenced keeping a private record of gasoline stove accidents, and so far have a list of eight." (Eight accidents in one city of the size of Detroit in four and one-half months is certainly not a good record.)

An insurance agent doing business in one of the leading towns of the State, a city of about 20,000, inhabitants, and who has given special attention to this subject, states on the authority of the chief engineer of the city fire department that eight fires from gasoline stoves have occurred in that city within four years, aggregating a loss of several thousand dollars; and adds that in his opinion "the first duty of every municipality in the State of Michigan should be the adoption of a rigid law relative to, and governing the storage and use of gasoline, and the issuing by circular or other efficient means of information to the people, educating and admonishing them as to its nature and its use; better still, an ordinance excluding it altogether." He pronounces gasoline "more dangerous to have around than gunpowder."

The secretary of a large insurance company writes: "Our impression from the accounts in the daily papers is that the losses of life and property (from the use of gasoline as fuel) have been very considerable." "As every one must be aware who reads the newspapers, the losses to life and property are much too frequent and disastrous. As insurers, we should be glad to see its use for fires entirely abandoned."

Another general agent writes: "There have been a great number of accidents from the use of gasoline stoves," and states, "I would not permit one in my house under any circumstances." "The stoves of to-day are doubtless of better make than the first, but guarded with even the perfection of care the insidious vapor arising from gasoline is extremely dangerous, and seizes every opportunity to join itself to fire or light however distant."

An insurance agent residing at Jackson, Mich., mentions two deaths as having occurred in that city from the result of gasoline, of which he says: "In the cases mentioned, the death of one, Mrs. G. Stevenson, was caused by setting the can too close to the flame of the stove, thereby causing it to explode, throwing the gasoline all over her. The death of Mrs. A. Porter was occasioned by grease igniting on the stove, the heat from which caused the tank to explode, scattering the gasoline over her." He adds, "The chief of our fire department informs me that the department has been called out nineteen times by reason of leak and explosion of gasoline stoves within two years."

Another general agent states: "We have paid several losses for fire caused by the explosion of gasoline stoves. Where great care is exercised, they may be used safely; but familiarity renders people careless."

A State agent of one of the largest Insurance Companies in the country writes: "If I should express my own opinion on the subject, it would be as follows: Gasoline is by its very nature a dangerous substance to have anywhere; further, the gasoline stoves in general use, while very well constructed, and fairly good when new, will get defective while in use, and when defective are very dangerous, and a possible source of great damage to life and property. I consider their use in any family composed in part of young children to be almost criminal."

Descriptions of a number of cases of loss of life occurring through the use of gasoline in connection with gasoline stoves were included in the replies received. In most of these cases, the explosion occurred as the result of turn-

ing on a little too much gasoline before lighting it, placing the can or other vessel holding gasoline too near the flame of the stove, or lighting a match in the vicinity of an open can. Nearly all of these accidents may be charged to carelessness; but is it not questionable whether an article which by so slight neglect or carelessness may be productive of so great mischief is not too dangerous an article for domestic use? The majority of domestics are habitually careless, especially respecting matters in which they have not been trained to careful habits. When we add to this fact the ignorance respecting the dangerous character of the substance which they are handling and the soothing assurance of the manufacturer and dealer that the particular style of stove in use is "perfectly safe," is it not remarkable that the number of distressing and fatal accidents is not vastly greater than it is?

Attention should be called to the fact that the statistics of losses from various causes are misleading as regards the danger from the use of gasoline. While it is true that fewer fires result from gasoline than from defective chimneys, stoves, or kerosene lamps, it must be recollected that the number of each of these causes in active operation is vastly greater than the number of gasoline stoves. The loss from eleven explosions in 1886 was $154,000.

We found in the circular of one of the leading manufacturers an inadvertent confession of the dangerous character of these stoves in the statement that a particular device recently added to this special stove "makes this the safest and simplest stove on the market."

In a letter received from the manufacturer of another popular stove, the acknowledgment is made that "the gas from gasoline when allowed to evaporate, mixed with air, is stuff that is explosive." To allay fears, however, the same writer added, "you are all right if you do not go near it with a lamp or fire of any kind." If this were true, the thing which is forbidden is precisely what some child or thoughtless person is certain to do, and, as previously mentioned, even if no person takes a lamp or fire to the gasoline, the gasoline may vaporize and go some distance to a lamp or fire, when the most disastrous results are likely to follow.

Is it not a very grave question whether the acknowledged convenience of gasoline as a fuel is not vastly more than counterbalanced by the positive dangers involved in its use?

RULES FOR THE USE AND CARE OF GASOLINE.

Every person employing or keeping gasoline should keep constantly in mind the following facts and cautions respecting its use:

1. Gasoline is an extremely dangerous, explosive substance.

2. It should be kept in a cool, well ventilated place, if possible out of doors, or in an out-building; never in a kitchen, closet, or cellar.

3. A vessel containing gasoline, unless tightly closed, should never be brought within ten feet of a lamp, stove, grate, flame, or fire of any sort. The small flame of a match or even a spark is sufficient to explode the gas when present in sufficient quantity.

4. The vapor of gasoline may be carried by a draught or current of air, and thus be brought in contact with fire at considerable distance, even greater than that mentioned in the preceding paragraph; consequently gasoline should never be opened or poured from one vessel to another in a current of air, unless the current is from the room out of doors.

5. The danger in connection with the use of gasoline stoves is not so much in the stoves themselves as in having the gasoline about; yet by continued use, the valves of a stove may become worn so that leaks may occur, and thus a stove may become a source of great danger.

6. If an overflow of gas occurs from being turned on too freely, from leakage of valves, or from the blowing out of the generating burner, as sometimes accidentally occurs, the surplus gasoline should be carefully wiped up, and the room should be well aired by the opening up of windows and doors before the burner is lighted.

7. If an open vessel containing gasoline has been standing in a room over night, or an overflow has occurred during the night, or if there is is found in a room a strong smell of gasoline at any time, the room should be opened and well aired, and before a match is lighted or a lighted lamp or candle carried into the room.

8. Gasoline should never be used for lighting a fire. An explosion, which may possibly be fatal in its effects, is almost certain to follow. Persons have been maimed for life in this way.

9. The use of gasoline lamps is, if possible, attended with even greater dangers than the use of gasoline stoves.

10. A wise regard for safety will lead to the disuse of gasoline in any form for domestic purposes.

11. Gas or kerosene stoves may be safely substituted for gasoline stoves, but neither gas, gasoline, nor kerosene stoves are so safe or healthful as the ordinary wood or coal stove. The ordinary stove aids in the ventilation of the room, and carries away the poisonous gases formed by the combustion of the fuel, whereas the other forms of stoves discharge the products of combustion into the air of the room, compelling the occupants to breathe the poisonous gases. Neither gas, gasoline, nor kerosene stoves should ever be employed in other than very open or well ventilated rooms, unless provided with a special flue or ventilating duct for the purpose of carrying off the products of combustion.

Respectfully submitted,

J. H. KELLOGG.

PRINCIPAL METEOROLOGICAL CONDITIONS IN MICHIGAN IN 1886.

A COMPILATION OF REPORTS BY OBSERVERS FOR THE STATE BOARD OF HEALTH AND FOR THE UNITED STATES SIGNAL SERVICE.

COMPILED UNDER THE DIRECTION OF THE SECRETARY OF THE STATE BOARD OF HEALTH.

For each of the years 1877 to 1885, inclusive, there has been published in the Annual Reports of this Board a summary relative to the principal meteorological conditions as observed during the year. This paper continues the subject for the year 1886. The names of the observers for 1886 and the months for which copies of their registers of meteorological conditions were received from each are stated in Exhibit 1, page 30. In Exhibit 2, page 31, is given the latitude, longitude, and elevation of each station. In the tables which follow, reports received from any observer for less than half the year have not been used.

The principal conditions treated in the following tables are temperature and humidity of the air, cloudiness, fogs, rainfall, ozone, velocity and direction of the wind, and pressure of the atmosphere. The tables on each subject are illustrated by diagrams representing to the eye variations in the given condition from month to month through the year, at the several localities represented.

These tables give not only meteorological conditions for the year and month under consideration, but they also contain, for purposes of comparison, statements of the average conditions for the longest period available in each case.

In the article on this subject in the last Annual Report, some of the uses and prospective uses of meteorological statistics, in studying the causation of diseases were mentioned, and in the latter part of the same volume there was published an article on "The Causation of Pneumonia," in which extensive use was made of meteorological statistics, especially those relating to the meteorology of Michigan. Further on in this report, in an article entitled "The Relations of Certain Meteorological Conditions to Diseases of the Lungs and Air Passages," many diseases are proved to sustain very close relations to meteorological conditions.

The article in this report in relation to "Causes of Diseases," based upon weekly reports of sickness in Michigan, may well be studied in connection with this article, the main purpose of which is to serve as a basis for studies of the causes of diseases.

EXHIBIT 1.—*Names of observers whose Reports are summarized in the following Meteorological Tables and Diagrams, their Places of Observation, and the Counties and Geographical Divisions of the State in which these places are situated, and months for which reports were received from each observer.*

Name of Observer.	Place of Observation.	County.	Divisions of the State.*	Months (inclusive) for which Registers were received.
P. M. Hutchinson, Sergt. Signal Corps, U. S. A.	Marquette	Marquette	U. P.	January to March.
W. W. Dent, Corp'l Signal Corps, U. S. A.	Marquette	Marquette	U. P.	April to December.
Arthur Beebe	Manistique	Schoolcraft	U. P.	January to May.
Arthur Beebe	Gulliver Lake	Schoolcraft	U. P.	June to December.
L. M. Pindell, Sergt. Signal Corps, U. S. A.	Escanaba	Delta	U. P.	January to July.
Titus W. Townsend, Corporal Signal Corps, U. S. A.	Escanaba	Delta	U. P.	August to December.
S. E. Wait	Traverse City	Gr. Traverse	N. W.	January to December.
Geo. M. Chappel, Corp'l Signal Corps, U. S. A.	Mackinaw City	Cheboygan	N.	January to December.
James J. Fitz Gerald, Sergt. Signal Corps, U. S. A.	Alpena	Alpena	N. E.	January to December.
D. W. Mitchell, M. D.	Harrisville	Alpena	N. E.	January to December.
Joseph E. Mueller, Sergt. Signal Corps, U. S. A.	Grand Haven	Ottawa	W.	January to December.
John P. Stoddard, M. D.	Muskegon	Muskegon	W.	January to December.
G. H. Cleveland, M. D.	Pentwater	Oceana	W.	January to December.
E. S. Richardson, M. D.	Reed City	Osceola	W.	January to July.
W. B. Rosevear	Bay Port	Huron	B. & E.	August to December.
John J. Granville	East Saginaw	Saginaw	B. & E.	January to December.
John W. Kimball	Port Austin	Huron	B. & E.	January to October.
Wm. M. Edmondson, Corp'l Signal Corps, U. S. A.	Port Huron	St. Clair	B. & E.	January to December.
John S. Caulkins, M. D.	Thornville	Lapeer	B. & E.	January to December.
Prof. R. C. Kedzie	Agr'l College	Ingham	C.	January to December.
Prof. J. W. Ewing	Ionia	Ionia	C.	Jan. to Apr., July to Dec.
E. H. McCallum	Office State B'd of Health, Lansing	Ingham	C.	January to Nov. 10.
H. S. Bartholomew	Office State B'd of Health, Lansing	Ingham	C.	November 10 to Dec.
G. G. Gordon, M. D.	Swartz Creek	Genesee	C.	January to December.†
Milton Chase, M. D.	Otsego	Allegan	S. W.	January 20 to Dec.
Prof. M. W. Harrington	University of Michigan, Ann Arbor.	Washtenaw	S. C.	January to December.
J. H. Kellogg, M. D.	Battle Creek	Calhoun	S. C.	Jan. and Feb., Mar. to Aug. and Oct. to Dec.
Lieut. A. H. Boies	Hudson	Lenawee	S. C.	January to December.
Geo. C. Palmer, M. D., Supt. Asylum for Insane	Kalamazoo	Kalamazoo	S. C.	January to December.
W. T. Drake	Marshall	Calhoun	S. C.	January to December.
Lewis Marvill	Parkville	St. Joseph	S. C.	January to December.
S. Alexander	Birmingham	Oakland	S. E.	Jan. to June, Oct. to Dec.
Norman B. Conger, Sergt. Signal Corps, U. S. A.	Detroit	Wayne	S. E.	January to October 14.
F. W. Conrad, Sergt. Signal Corps, U. S. A.	Detroit	Wayne	S. E.	October 15 to December.

* The counties in each division are stated in Exhibit I, in the article on weekly reports of sickness.
† The Registers from Swartz Creek for the months, July to November, inclusive, were received after the tables were made, and data for the year 1886 could not be included in the average line for stations.

EXHIBIT 2.—*Latitude and Longitude, Elevation above Sea Level, and the Average Temperature, and Average Barometric Pressure in 1886, at 27 Meteorological Stations in Michigan, the names of the Stations being arranged in order by Latitude, highest first.*

Localities in order of Latitude, those farthest North, first.	Latitude North.	Longitude West from Greenwich.	Altitude (Approximate) above Sea Level,—Feet.	Height of Mercury in Cistern of Barometer above Sea Level,—Feet.	Average Temperature 1886, Degrees Fahr.	Average Atmospheric Pressure, 1886. Inches of Mercury Corrected for Temp.
Marquette	46°34′	87°24′	641.42	671.79	39.73	29 257
Gulliver Lake	45°59′	86°1′	618.	621.		
Manistique	45°58′	86°15′	598.	602.8		
Escanaba	45°48′	87°5′	587.699	608.	39.69	29.331
Mackinaw City	45°47′	84°39′	587.02	605.	41.55	29.322
Alpena	45°5′	83°28′	589.	609.	40.53	29.333
Traverse City	44°45′	85°40′	598.	602.5	43.73	29.307
Harrisville	44°39′	83°18			43.28	29.312
Port Austin	44°	82°	b 472.			
Pentwater	43°45′	86°35′			44.80	
Reed City	43°44′	85°28′	1,016.	1,022.		
East Saginaw	43°25′.1	83°57′.8	604.	609.5		
Muskegon	¶ 43°13′	¶ 86°15′	593.		46.51	
Grand Haven	43°5′	86°18′	595.3	620.	44.91	29.328
Port Huron	43°	82°26′	e 603.	f 633.	44.33	29.322
Ionia	† 42°59′	† 85°4′		786.6		
Swartz Creek	42°57′	83°49′	800.			
Thornville	* 42°55′	* 83°10′	975.	980.	48.02	28.937
Agricultural College	42°44′	84°29′	820.	834.	46.20	29.089
Lansing	‡ 42°44′	‡ 84°33′	a 900.	a 917.	46.19	29.075
Birmingham	42°30′	83°10′	§ 752.			
Detroit	42°20′	83°3′	c 585.	d 661.	48.95	29.314
Battle Creek	* 42°20′	* 85°11′	§ 800.			
Ann Arbor	42°17′	83°44′	930.	936.	46.76	29.024
Marshall	42°17′	84°55′	885.	888.	49.29	29.026
Kalamazoo	42°13′	85°35′	975.	987.	47.46	28.907
Hudson	41°53′	84°21′	970.			

* Estimated from lines on a map of Michigan issued by the General Land Office, Department of the Interior, 1878. For stations having no reference mark, the latitude and longitude were stated by the observer on the meteorological reports received.

† The exact latitude and longitude of the astronomical post at Ionia is 42°58′ 52.53″ N. and 85°3′ 49.20″ W.

‡ The exact latitude and longitude of the astronomical post placed in the ground near the new Capitol at Lansing, by the U. S. Lake Survey in 1875, as determined by the observations then made, is 42°43′ 53.11″ N. and 84°33′ 19.68″ W.

§ Estimated from data on "Railroad Profiles," pages 179–187, Annual report of the State Board of Health for 1878.

‖ Estimated from data in Tackabury's Atlas of the State of Michigan.

¶ According to table in Tackabury's Atlas of the State of Michigan.

a Estimated from comparisons of barometrical observations at Lansing, Port Huron, and Grand Haven, for the four years, 1879–82. b 478 in May, June, July, August, September. c 586 in August, September, October, November, and December. d 662 in August, September, October, November, and December. e 602 in November and December. f 639 in November and December.

NOTE.—Green's standard barometer was used at the above stations for the year 1886, Kalamazoo excepted. The barometer at Kalamazoo was manufactured by J. Foster, Cincinnati, Ohio.

METEOROLOGICAL CHARACTERISTICS OF THE YEAR 1886.

Among the most remarkable characteristics of the meteorological conditions of 1886 was the drouth which prevailed during the months of June and July, and which, by its baneful influence in drying up pastures, and stunting the growth of those crops which needed moisture at that season, proved so injurious to the agricultural interests of the State. Observers report from various parts of the State, that, as a result of this drouth, corn, potatoes and some other crops fell short of an average yield, and that farmers were obliged to resort to dry feed for their "stock" at a much earlier period than is usual.

The effect of the drouth on the depth of water in wells and upon the sickness from typhoid fever will be noticed further on in this article and in the article on "Causes of Diseases—Weekly Reports."

Although the annual average amount of precipitation (at 18 stations in Michigan) during the year 1886, was only 3.66 inches less than (at 17 stations) in 1885, and 5.02 inches less than the average (of groups of stations in Michigan) for the ten years 1877–86, this shortage in the precipitation nearly all occurred during the months of June and July, the aggregate rainfall in those two months being 3.14 inches less in 1886 than in the corresponding months of 1885, and 4.18 inches less than the average for those months, in the ten years 1877–86.

This drouth was not confined to Michigan. Reports received at this office from meteorological exchanges and correspondents in other States testify to its having existed in those States, followed by injurious results similar to those noted in this State.

METEOROLOGICAL CHARACTERISTICS OF THE YEAR 1886, AT ONE CENTRAL STATION.

At the State Agricultural College, near Lansing, and near the center of the thickly settled part of the State, the average temperature for 1886 was 3.30° higher than for 1885, and 27° lower than the average for the preceding 22 years; the annual range of temperature was 3° less than in 1885, and 2° less than the average annual range for the preceding 13 years; the average monthly range of temperature was 4° greater than in 1885, and 1° greater than the average for the 13 preceding years; the average daily range of temperature was 1.24° greater than in 1885, and 43° less than the average for the preceding 12 years; the average cloudiness was 1 per cent less than in 1885, and 1 per cent less than the average for the preceding 22 years; the rainfall (rain and melted snow) was 7.05 inches less than in 1885, and 4.52 inches less than the average for the preceding 22 years; the average atmospheric pressure was .021 of an inch greater than in 1885, and .031 of an inch greater than the average for the preceding 11 years. In Exhibit 3, pages 34 and 35, is given by year and months, a comparison of conditions in 1886, at the Agricultural College, with those in 1885, and with average for periods of years. April, October, September and March (naming months in order of greatest difference) were months in which the average temperature in 1886 was higher than the average for corresponding months in the preceding 22 years; December, January, June, February, November, July and May were months in which the average temperature in 1886 was lower than the average for corresponding months in the preceding 22 years, at that station, which is near the central part of the State.

Whoever will carefully study Diagram No. 1 (p. 46) in this article and in similar articles for preceding years, will see that thermometers and methods of observation have become so perfect that, given a curve representing correctly the temperature by months at one station in Michigan, curves can readily be constructed without actual records which will somewhat closely represent the temperature at each of several other stations, because the curves for many stations run so nearly parallel that all that is necessary to do is to find the average difference of mean annual temperature at the station to be represented compared with the station for which the data are given. It may also be seen that a curve representing the temperature at a station in the central part of the State very closely resembles the curve representing the average for many stations representing nearly all parts of the State. This proves that the practice adopted many years ago of stating the meteorological characteristics at one central station is a reasonably safe practice, and it is especially useful when it enables us to gain a comparison for a longer period than can be made from records at many stations, and also when employed in advance of the receipt of records from all stations, as is the case when the weekly bulletins of "Health in Michigan" are issued, for the purposes of which the meteorological conditions at the State Capitol are used to represent the conditions probably prevailing throughout the State.

EXHIBIT 5.—*Average temperature, by year and months, in 1886,* compared with annual and monthly averages for the ten years, 1877-1886. These averages are for groups of several stations in Michigan.*

Years, etc.	Average Temperature.—Degrees Fahr.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 yrs., 1877-86*.	46.11	20.56	23.62	29 80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.60
Av. 8 yrs., 1879-86....	45.39	19.91	21.77	28.82	43.04	55.98	64.79	69.78	66.25	61.11	50.68	35.56	25.82
1885 (21 stations)....	42.36	15.46	10.21	19.51	41.39	53.32	63.39	71.13	63.23	59.14	45.78	38.14	27.59
1886 (17 stations)....	44.82	18.72	21.18	30.10	46.04	54.69	63.31	68.68	67.36	61.15	51.84	34.32	20.44
In 1886 **Higher** than Av. for 10 yrs. 1877-86.....	.....	.....	.....	0.30	1.71	.....	.....	.....	.....	.....	1.01	.....	.....
In 1886 **Lower** than Av. for 10 yrs., 1877-86.....	1.29	1.84	2.44	.....	.....	1.39	1.79	1.84	0.78	0.52	.....	1.72	6.16
In 1886 **Higher** than in 1885.....	2.46	3.26	10.97	10.59	4.65	1.37	.....	.....	4.13	2.01	6.06	.....	.....
In 1886 **Lower** than in 1885.....	.....	.....	.....	.....	.....	.....	0.08	2.45	.....	.....	.....	3.82	7.15

NOTE.—The stations represented in the lines for average temperature for the years 1877-86 in Exhibit 5, are the following: Thornville, Kalamazoo, Detroit, for 1877-86; Mendon for 1877-82; Tecumseh for 1877-85; Battle Creek for 1877-80, 1882, 1885; Nirvana for 1877-9 and first four months of 1880; Reed City for last eight months of 1880 and 1881-5; Coldwater, Ypsilanti, Woodmere Cemetery (near Detroit) for 1877-9; Otisville for 1878-80, 1882; Niles for 1878-9, 1881; Marquette for 1879-84 and 1886; Alpena, Grand Haven, Port Huron, Lansing for 1879-86; Washington for 1879-83; Benton Harbor for 1877-8; Agricultural College for 1877 and 1881-6; Petoskey for 1878-9; Escanaba for 1880-86; Harrisville for 1881-2 and 1885-6; Ann Arbor for 1881-6; Parkville for 1881-2; Traverse City, Marshall for 1882-6; Hillsdale for 1882-4; Winfield for 1881 and 1883; Hudson and Mallory Lake for 1881; Ionia for 1883-5; Manistique, Swartz Creek for 1884-5; Mackinaw City for 1884-6; Port Austin for 1885; Muskegon, Pentwater for 1886.

* Beginning with the year 1885, allowance must be made for Lansing in Exhibit 5, because of a change in the location of the instruments. The amount of the variation by months is shown in Exhibit A, on page 22, Report for 1885.

EXHIBIT 3.—*Statements of Meteorological Conditions in the Year and in each Month of the Year 1886, Compared with annual and Monthly Averages for 1885, and for several Stated Periods of Years—from Observations by Prof. R. C. Kedzie, at the State Agricultural College near Lansing, Michigan.*

Meteorological Conditions.	1886 Compared with Averages for Previous Years.		In 1886	Meteorological Conditions.	1886 Compared with Averages for Previous Years.		In 1886
	No. of Years Averaged, endi'g with 1885.	More (+), or Less (-), in 1886 than the Average for Previous Years.	More (+), or Less (-), than in 1885.		No. of Years Averaged, endi'g with 1885.	More (+), or Less (-), in 1886 than the Average for Previous Years.	More (+), or Less (-), than in 1885.
YEAR 1886.				YEAR 1886. *Continued.*			
Av. Temp.	22	-0.27°	+3.30°	Cloudiness	22	-1 per ct.	-1 per ct.
Range of Temp*	13	-2°	-3°	Rainfall	22	-4.52 in.	-7.05 in.
Av. Monthly Range of Temp*	13	+1°	+4°	Atmospheric Pressure	11	+ 031 in.	+.021 in.
Av. Daily Range of Temp*	12	-0.43°	+1.24°				
JANUARY.				FEBRUARY.			
Av. Temp.	22	-3.01°	+3.44°	Av. Temp.	22	-1.54°	+13.33°
Range of Temp*	13	+3°	-2°	Range of Temp*	13	+10°	+1°
Av. Daily Range of Temp*	12	-3.44°	-3.88°	Av. Daily Range of Temp*	12	-2.73°	-7.68°
Cloudiness	22	+5 per ct.	+2 per ct.	Cloudiness	22	+1 per ct.	+16 per ct.
Rainfall	22	+0.91 in.	-0.04 in.	Rainfall	22	-0.63 in.	+0.62 in.
Atmospheric Pressure	11	-.024 in.	-.083 in.	Atmospheric Pressure	11	+.032 in.	+.087 in.
MARCH.				APRIL.			
Av. Temp*	22	+0.27°	+10.07°	Av. Temp.	22	+4.66°	+6.59°
Range of Temp*	13	=	+3°	Range of Temp*	13	+2°	=
Av. Daily Range of Temp*	12	-3.56°	-5.04°	Av. Daily Range of Temp*	12	-1.74°	+1.90°
Cloudiness	22	-3 per ct.	+8 per ct.	Cloudiness	22	+1 per ct.	-3 per ct.
Rainfall	22	+0.04 in.	+2.05 in.	Rainfall	22	-0.51 in.	-0.48 in.
Atmospheric Pressure	11	-.011 in.	-.093 in.	Atmospheric Pressure	11	+.100 in.	+.016 in.
MAY.				JUNE.			
Av. Temp.	22	-0.04°	+2.30°	Av. Temp.	22	-2.02°	+1.03°
Range of Temp*	13	-8°	-10°	Range of Temp*	13	-2°	+3°
Av. Daily Range of Temp*	12	-1.57°	+2.45°	Av. Daily Range of Temp*	12	-0.48°	=
Cloudiness	22	-5 per ct.	-9 per ct.	Cloudiness	22	-3 per ct.	+4 per ct.
Rainfall	22	-0.46 in.	+0.37 in.	Rainfall	22	-2.45 in.	-4.09 in.
Atmospheric pressure	11	-.014 in.	+.035 in.	Atmospheric Pressure	11	+.023 in.	-.050 in.

* By registering thermometers, set at 7 A. M., and recorded at 7 A. M., for the preceding calendar day.

EXHIBIT 3.—CONTINUED—*Meteorological Conditions at the Agricultural College, in Months for the Year 1886, Compared with averages for Corresponding Months in Preceding Years.*

Meteorological Conditions.	1886 Compared with Averages for Previous Years.		In 1886	Meteorological Conditions.	1886 Compared with Averages for Previous Years.		In 1886
	No. of Years Averaged, endi'g with 1885.	More (+), or Less (-), in 1886 than the Average for Previous Years.	More (+), or Less (-), than in 1885.		No. of Years Averaged, endi'g with 1885.	More (+), or Less (-), in 1886 than the Average for Previous Years.	More (+), or Less (-), than in 1885.
JULY.				AUGUST.			
Av. Temp	22	-0.83°	-2.02°	Av. Temp	22	+0.52°	+5.68°
Range of Temp*	13	+1°	+5°	Range of Temp*	13	+1°	+12°
Av. Daily Range of Temp*	12	+2.45°	+4.71°	Av. Daily Range of Temp*	12	-1.60°	+4.45°
Cloudiness	22	+2 per ct.	+5 per ct.	Cloudiness	22	-3 per ct.	-8 per ct.
Rainfall	22	-2.94 in.	-1.87 in.	Rainfall	22	+1.88 in.	-1.13 in.
Atmospheric Pressure	11	+.001 in.	-.001 in.	Atmospheric Pressure	11	-.021 in.	-.012 in.
SEPTEMBER.				OCTOBER.			
Av. Temp	22	+1.74°	+3.13°	Av. Temp	22	+4.08°	+7.42°
Range of Temp*	13	-4°	+7°	Range of Temp*	13	-8°	-5°
Av. Daily Range of Temp*	12	-2.98°	+0.07°	Av. Daily Range of Temp*	12	+2.21°	+4.74°
Cloudiness	22	+6 per ct.	+11 per ct.	Cloudiness	22	+10 per ct.	-11 per ct
Rainfall	22	+2.48 in.	+1.65 in.	Rainfall	22	-1.74 in.	-2.13 in.
Atmospheric Pressure	11	+.031 in.	+.020 in.	Atmospheric Pressure	11	+.179 in.	+.197 in.
NOVEMBER.				DECEMBER.			
Av. Temp	22	-1.42°	-3.28°	Av. Temp	22	-5.74°	-8.01°
Range of Temp*	13	+13°	+26°	Range of Temp*	13	+7°	+8°
Av. Daily Range of Temp*	12	+2.92°	+6.44°	Av. Daily Range of Temp*	12	+5.18°	+6.75°
Cloudiness	22	-3 per ct.	-15 per ct.	Cloudiness	22	-8 per ct.	-13 per ct.
Rainfall	22	-0.78 in.	-1.42 in.	Rainfall	22	-0.36 in.	-0.58 in.
Atmospheric Pressure	11	-.017 in.	+.048 in.	Atmospheric Pressure	11	+.093 in.	+.111 in.

*By registering thermometers, set at 7 A. M., and recorded at 7 A. M., for the preceding calendar day.

Comments on Exhibit 3 are printed on page 32.

The mild weather for October, and the small amount of rainfall for April, June, July and October are especially noticeable.

LOCAL METEOROLOGICAL PHENOMENA IN THE SEVERAL MONTHS OF THE YEAR 1886.

The following general remarks relative to temperature, frosts, effects on vegetation, migration of birds, etc., in 1886, are taken from the monthly reports by observers. The names of observers are stated in Exhibit 1, page 30.

JANUARY.

Jan. 28. Heavy frost at 7 A. M.—*Marquette.*

Frosts Jan. 1 to 31, inclusive. Ice formed Jan. 1, and 3, to 31, inclusive. Little Bay de Noquette frozen over.—*Escanaba.*

Frosts Jan. 12, 13, 14, 23, 24. Ground frozen about 3 feet 1 inch. River frozen over Jan. 7. Navigation closed Jan. 8.—*Alpena.*

Frosts Jan. 2, 12, 13, 14. River frozen Jan. 6.—*Port Huron.*

Trees covered with rime Jan. 29, 30, till noon. Jan. was a cold, cloudy month. First half of the month bare ground, the last very good sleighing. Ice on ponds at close 12 inches thick.—*Thornville.*

Jan. 23, coldest morning of the season. *Ann Arbor.*

Frost Jan. 2.—*Birmingham.*

Jan. 2, Grand River opened in the night of Jan. 1 to 2. Frost Jan. 28. Frost all out of ground Jan. 4. Grand River frozen over (second time this season) night of Jan. 6 to 7. Jan. 16, melting snow on ground. About eight inches of snow on ground at the close of the month.—*Lansing.*

Jan. 9, ice three miles from shore. Jan. 12, ice 14 inches thick in the harbor. Ice broke up in harbor Jan. 13. Jan. 14, lake and harbor open. Jan. 26, ice three miles from shore in Lake Michigan.—*Manistique.*

FEBRUARY.

Frosts Feb. 13, 17, 27.—*Marquette.*

Frosts Feb. 1 to 10, and 12 to 28, inclusive. Ice Feb. 1 to 10, 12 to 24 and 25 to 28, inclusive. Thaws Feb. 7, 8, 9, 10, 11, 12, 13, 18, 24. Little Bay de Noquette frozen.—*Escanaba.*

Grand Traverse Bay frozen over Feb. 1. Frost Feb. 8. Thunder on night of Feb 24.—*Traverse City.*

Light frosts Feb. 1, 4, 5, 10, 18, 22, 23, 27, 28. Killing frosts, Feb. 3, 4, 9. Ground frozen four feet.—*Alpena.*

Melting snow on Feb. 7, 8, 23, 24.—*Pentwater.*

Feb. 28, ice out as far as one can see.—*Port Austin.*

Feb. 7, snow melting fast. Feb. 10, snow has disappeared.—*East Saginaw.*

Frosts Feb. 3, 4, 10, 24, 28.—*Port Huron.*

Nights that it did not freeze, Feb. 10, 11, 12. Pair of robins seen Feb. 28. Feb. was a dry, windy month, remarkable for its great changeableness. The extreme range of temperature being 60° and the barometer 1.16 in. There was not much sleighing, the snow being blown into drifts and melted with the sudden warm changes. On account of the bareness of the ground the frost has penetrated into it deeply in open places. The ice on the ponds is nearly two feet thick. It is thought that the wheat on the ground is considerably injured.—*Thornville.*

Feb. 13, high temperature for last five days; snow gone except patches here and there. Month opened and closed with cold snap. The warmest weather was on Feb. 9 (49°). Cold wave on the 16th. No snow on the ground as the month closes, except very small and widely separated patches.—*Ann Arbor.*

Robins observed Feb. 12 and 14.—*Hudson.*

Melting snow Feb. 9.—*Birmingham.*

Melting snow on ground Feb. 9, 11, 13, 14, 18, 19, 23. Feb. 24, snow has disappeared except in places where it had been drifted and piled up. First robin seen Feb. 19. Cherry birds first seen Feb. 20. Light frost Feb. 24. Feb. 25, snow all gone except in small isolated spots.—*Lansing.*

Ice three miles from shore in Lake Michigan Feb. 4. Ice broke up in Lake Feb. 5. Harbor open Feb. 8. Two large flocks of geese flying north Feb. 9. Flock of geese flying north Feb. 10. Squirrels out in the woods Feb. 24. 32 inches of snow on the ground at the close of the month.—*Manistique.*

Frosts Feb. 2, 3, 4, 27.—*Swartz Creek.*

MARCH.

Frosts March 12, 16, 28.—*Marquette.*

Frosts March 1 to 31, inclusive. Ice March 1 to 24, and 26 to 31, inclusive. Thaws March 3 to 7, inclusive; 10, 12, 15 to 19, inclusive; 23 to 28, inclusive, and 30. Little Bay De Noquette frozen.—*Escanaba.*

Frosts March 4, 5, 6, 10, 25, 27, 28.—*Mackinaw City.*

Frosts March 1 to 6, inclusive; 10, 11, 17, 23 to 28, inclusive; and 30. Ground frozen 9 inches.—*Alpena.*

Melting snow March 3, 4, 5, 6, 7, 8, 9, 12, 16, 17 and 18.—*Pentwater.*

Heavy white frosts March 6, 7, 10. March 16, robins, bluebirds and crows put in their appearance. *Port Austin.*

Frosts March 4, 5, 16. Robins appeared Feb. 20.—*East Saginaw.*

Frosts March 1, 2, 5, 6, 7, 11, 14, 17, 24, 28.—*Port Huron.*

March 13, honey bees flying. March 14, first chipmunk seen. Mosquitoes around, March 29. Migratory birds first seen as follows: Robins, March 20; chip and song sparrows, killdeer, March 19; meadow lark, March 19; blackbirds and hawk March 23; large flock of cedar birds, March 31. Crocus in blossom March 28.

March was a rather dry month. First week roads dry and dusty; froze every night more or less; very slightly March 24. Frost out of the ground at close on southern exposures. The month was remarkable for the lowest barometrical pressure ever observed here, 28.15 at 7 A. M., March 21. The top of the wheat is all killed, but the roots seem mostly uninjured.—*Thornville.*

Frosts March 1, 2, 3, 4, 5, 6, 7, 10, 11, 14, 15, 16, 17, 24, 25, 26, 27, 28.—*Swartz Creek.*

Frosts March 5, 6, 7, 17. Robins seen March 8, chewink March 22, and blackbirds March 24.—*Ann Arbor.*

First appearance of birds: Robins, March 5; bluebirds, March 11; blackbirds and song sparrows, March 16.—*Hudson.*

Frosts March 5, 11, 17. First song birds, March 5.—*Birmingham.*

Light frosts March 2, 3, 4, 11, 24, 26, 28. Heavy frosts March 5, 6, 7, 17. Melting snow on ground March 12. Bluebirds first seen March 8; blackbirds first seen March 13; chipping birds first seen March 18. Ice began moving in Grand River March 18; ice all out of Grand River March 19. Frogs first heard March 19. Frost all out of ground March 26.—*Lansing.*

First crows seen March 4. Lake Michigan and Manistique harbor entirely open March 18. Steamer C. W. Moore, first boat of 1886, arrived from Chicago March 27. Fishing tugs commenced setting nets March 27.—*Manistique.*

APRIL.

Frosts April 1 to 15 inclusive, and April 17 to 29 inclusive. Ice April 1, 2, 3, 4, 5, 6, 7. Thaw April 3 to 12, inclusive. Monthly temperature of Little Bay de Noquette, air, 51.1°; surface, 43.1°; bottom, 40.8°; depth, 18.2°.—*Escanaba.*

Robins arrive April 4, martins arrive April 17. Ice goes out of Grand Traverse Bay April 22.—*Traverse City.*

Heavy frost April 4.—*Mackinaw City.*

Frosts April 2, 4, 5, 7, 8, 9. River opened April 7, navigation opened April 15.—*Alpena.*

April 2, frogs are out. April 15, out-door flowers in blossom. April 18, first steamboat in. The spring opening up very fine, three weeks early.—*Port Austin.*

Frosts April 2, 3, 4, 7, 8, 13.—*East Saginaw.*

Frosts April 4, 5, 8, 9; melting snow on ground April 1, 2, 3, 8, 9, 10, 11.—*Port Huron.*

Progress of vegetation: Missouri currant leafing April 12; black raspberry leafing April 16; hazelnut in blossom April 17; silver leaf poplar, soft maple and willow in blossom April 19; apple trees and willow leafing April 21; cherry, elm and blackberry leafing April 23; sweet cherry in blossom April 26; plum in blossom April 29. Movements of migratory birds: Bluebirds seen April 3; chewinks seen April 9; bank swallows seen April 20; barn swallows seen April 22. Frogs first heard April 11. Last freeze April 11.

April was a warm, pleasant month, the average temperature of the last twenty days being almost the normal for May, and for the whole month 4° or 5° above its own normal. The progress of vegetation was rapid and the return of the migratory birds very early. According to my recollection swallows never came back before in April, nor were cherry trees in blossom. The wheat is not badly winterkilled, and is forward. Probably 10 per cent. will cover the area killed. The month is noteworthy for the worst snow storm remembered, on the 6th. Heavy snow fell all day, with a tremendous N. E. wind that drifted the roads in a way never known, making some, that were not shoveled out, impassable for a week. Afterwards the weather was fine as June till the end of the month.—*Thornville.*

No frosts.—*Ionia.*

Frosts April 5, 8, 9.—*Swartz Creek.*

Crocuses, snowdrops, elm and soft maple in blossom April 10. Saw a farmer plowing April 16. Bloodroot and Hepatica in full blossom April 16. Carex Pennsylvanica, Ranunculus Fascicularis, Antennaria Plantaginifolia and Anemone Nemorosa in full blossom April 25. Leaf buds of mountain ash expanded, and young leaves two and three inches long; grapevines on southern slopes bursting into leaf rapidly, saw many young shoots one-half to two inches long and young leaves one-half to one inch across, on yesterday, April 24. The remarkably warm weather of last two weeks has brought on vegetation wonderfully in spite of absence of rain. Peach trees in blossom April 26. Dandelions in blossom April 27. This month remarkable for long spell of fine, warm weather, beginning on the tenth and continuing uninterruptedly up to the thirtieth. During all this time we have had no frosts. The maximum temperature has ranged from 50° to 80°, being above 65° for 13 consecutive days, and the minimum temperature has ranged from 37° to 55°, being above 45° most of the time. Vegetation is much advanced for the season. Peach and cherry trees are in full bloom, apples are beginning to blossom, and grass has made a growth of several inches.—*Ann Arbor.*

Light frost April 28.—*Hudson.*

Frost April 28.—*Parkville.*

Chipping birds April 13; phoebe birds April 14; first robins, frogs first heard, April 16; large flock of geese going north April 20. Elders and balm of gilead sprouting April 21; cherries and raspberries sprouting April 27; trailing arbutus in blossom, April 28; adder tongue in blossom; a few banks of snow remain April 30.—*Manistique*

Frosts April 2 and 5, melting snow on ground Apri 1. Spring beauties and hepaticas in bloom, grass growing fast and looks green April 13; lilac and currant bushes in leaf, bloodroot (sanguinaria), Dicentra cuculata, and squirrel corn in bloom April 16; early apple trees leafing April 17, crocuses and hyacinths in bloom April 10, elms leafing and pear trees in bloom April 21.—*Lansing.*

MAY.

Frosts May 5, 8, and 25—*Marquette.*

Frosts May 2, 5, 6, 7, 8, 9, 15, 16, 17, 25, 26. Ice May 7, 16. Monthly temperature of Little Bay de Noquette: Air, 55°, surface, 50.2°, bottom, 48.3°, depth, 18 feet, 4 inches.—*Escanaba.*

Frosts May 6, 7, 17, 26. Ice May 6.—*Mackinaw City.*

Light frosts May 7 and 17.—*Alpena.*

Very light frost May 18.—*Port Austin.*

Frosts May 16 and 25.—*East Saginaw.*

Frost May 16.—*Marshall.*

Light frosts May 8 and 17.—*Port Huron.*

Frosts, May 8, 16, 17, 26, killed tender vegetation. May 1, maple and tamarack leafing; sour cherries in blossom May 2, apples in blossom May 3, yellow oak and grapevine leafing May 5, white oak leafing May 7, locust leafing May 16, locust in blossom May 28, blackberries in blossom May 30, wheat heading May 29.

May was a month with some anomalous conditions, with unusually fine sunshiny weather, the barometric pressure was very low; with a heavy rainfall, there were only four cloudy days; with a normal average temperature, there was very little hot weather. The season is very early, at least two weeks in advance of last year in respect to growth of vegetation and return of birds.

With the thunder storm of the night of the 26th a tornado crossed Lapeer county diagonally from the N. W. corner at Marathon to the S. E. at Almont. Its nearest approach to this place was 4½ miles north. No lives lost or severe injuries are reported. The damage was principally done to slightly built barns (large strong were only moved from their foundations), fences, orchards and fruit trees. Some houses are said to be badly torn up in Columbiaville, but they are not seriously injured in this part of the county. The worst that I saw was J. P. Smith's at Attica. Part of his windmill was sticking through the side of the house; some of the windmill was found four miles off. The track of the tornado was not wide, varying from 80 rods down to almost nothing, and was sharply defined, a frail corn house and a pile of stove wood at Smith's being left undisturbed not more than 3 rods from the demolished barn and windmill. There was hail of large size with the storm of wind. Cattle and sheep were killed, but no horses as far as I know.—*Thornville.*

May 7, apple trees in full blossom. Lilacs, Japan quince, flowering almond and horse chestnut in bloom; sugar maple in nearly full leaf. Light frost in low places. Some damage to tender plants. May 17, slight frost in low ground last night.—*Ann Arbor.*

Frosts May 5, 8, 15, 16, 25, 26, 27.—*Swartz Creek.*

Ice formed one-eighth inch thick night of May 7.—*Hudson.*

May 8, general frost, heavy in low places; May 17, heavy frost in low places; May 25, frost and frozen ground in low places; May 26, very heavy frost on low and flat ground. The spring has been remarkably early here. Fruit trees have blossomed three weeks earlier than they have been known to do before since the country has been settled.—*Birmingham.*

Frost (last one) on May 26.—*Parkville.*

May 1, swallows appear; May 2, hard maple leaves open; May 10, mountain ash in leaf, birch leaves open. Frosts May 7, 8, 12, 17, 25 and 26.—*Manistique.*

May 16, ice formed one-eighth inch thick in the night (15 to 16); May 17, white frosts on low grounds, tender vines and other plants injured to some extent, elm and soft maple seeds ripe and falling; May 25, frost was reported as having occurred this morning in the surrounding country; but none was observed at this station; May 26, frost reported from several localities in this vicinity; none observed at the Capitol. Fire flies first seen May 30.—*Lansing.*

JUNE.

June 8, frost, ice one-eight inch thick formed in spots; June 18, slight frost in spots.—*Gulliver Lake.*

Frosts June 3, 5, 6, 7, 8, and 18. Monthly temperature of Little Bay de Noquette: Air, 66.5°, surface, 59.6°, bottom, 57.3°, depth, 18 feet, 7 inches.—*Escanaba.*

June 7, frost.—*Traverse City.*

Light frost June 4; heavy frost June 6 and 8.—*Mackinaw City.*

Light frost June 6.—*Alpena.*

Light frost June 18.—*Grand Haven.*

Frost June 8.—*Pentwater.*

Light frost June 19.—*Port Huron.*

Haying began June 12. Fire flies first seen June 17.

A coolish and dry month, but not good hay weather till the 26th, on account of lack of evaporation, afterwards it was superb hay weather. The crop is large and will be mostly secured in good condition. Corn is small and oats poor and likely to be very smutty. Apples and cherries promise an abundant crop. The month was remarkable for only one cloudy day.—*Thornville.*

Light frost June 4.—*Hudson.*

Light frost on low lands June 4.—*Parkville.*

JULY.

Killing frost July 17.—*Marquette.*

Monthly temperature of Little Bay de Noquette: Air, 71.1°, surface, 64.7°, bottom, 63.2°, depth, 18 feet, 2 inches.—*Escanaba.*

July was a dry month with cool nights, favorable for saving the hay and wheat, but bad for the growing crops. Oats, early potatoes, young seeding and corn are all seriously hurt. The day temperature has been fairly warm with a few very hot days, but there has only been one night with a minimum temperature of 70° or more. As a consequence of this the growing corn is late. The dryness of the ground was unusual for the short time the drought lasted, all showers that fell during the last half of the month not having made any appreciable difference. Oats are very short and smutty as they can be. Some wheat is a little rusty. The apple crop promises well and huckleberries and blackberries are plenty.—*Thornville.*

AUGUST.

Katydid first heard August 10.

August 31, very cold and dry for the season. August was a continuation of the protracted drought which was partially broken by the rains of the 29th and 30th, the preceding showers having made no impression whatever. There were but a few really hot days and the nights were decidedly cool. Very good weather for saving the oats and helping the growing buckwheat, but poor for corn, potatoes and young seeding, much of which last will be lost. The mean temperature of the month is a little lower than the normal.—*Thornville.*

Earthquake August 31, at 9:25 P. M., standard time. The shock was moderate, sufficient to set suspended objects, chandeliers, etc., swinging.—*Port Huron.*

Light frost August 31.—*Hudson.*

Frost reported to have occurred one-and-one-half miles south of this station August 2, by which corn is said to have been seriously injured. None was observed at this station.—*Lansing.*

Frost in the county August 31.—*Harrisville.*

SEPTEMBER.

Light frosts Sept. 14 and 17; killing frost Sept. 21 and 28.—*Marquette.*

Light frosts Sept. 14, 20 and 28.—*Escanaba.*

Killing frost Sept. 21 and 29.—*Mackinaw City.*

First frost Sept. 13; first killing frost Sept. 21. Temperature Gulliver Lake 56° Sept. 18.—*Gulliver Lake.*

Light frosts Sept. 1, 13 and 20; heavy frosts Sept. 14 and 21.—*Alpena.*

Light frost Sept. 20.—*Port Austin.*

Frost on nights of Sept. 20, 28 and 30.—*East Saginaw.*

Frosts Sept. 13, 21 and 29.—*Port Huron.*

Frosts Sept. 1, 12 and 21, slight, killing only tender vegetation in low places.

September, till the 9th, was a continuation of the long drought, after very wet. Barometrical pressure was uncommonly high and temperature normal. From the lack of killing frosts the corn, what there is of it, became very ripe and sound. It is not more than half a crop, neither are the oats. Wheat is a fair average crop, and that growing looks excellently well, being generally early sowed. The wet has been bad for saving clover seed, but no great amount of damage has been done to the crop. Apples and peaches have exceeded expectations, the former being a good crop and the latter, too, wherever any trees are left. Late potatoes are good, early, nothing to speak of. In spite of all the rain (nearly five inches during last two-thirds of the month) there is still a stratum of dry earth below the wet. Migratory birds: Robins, bluebirds and blackbirds mostly left, about Sept. 20; catbirds, brown thrushes and orioles, early in the month. Yellow birds are still hanging around, and some of the first named are occasionally seen.—*Thornville.*

Light frosts Sept, 1, 10, 11, 12, 17 and 19.—*Hudson.*

Frost Sept. 1, 13, 20 and 22.—*Parkville.*

Wild geese flying south Sept. 29.—*Kalamazoo.*

Frost Sept. 1. No damage.—*Agricultural College.*

Frost reported to have been seen on low grounds. None was observed at this station (Sept. 1). Light frost was also reported as having occurred in this vicinity on Sept. 13, and that ice formed on that date, but neither frost nor ice was observed at this station. Light frost observed Sept. 28, first of the season seen at this station.—*Lansing.*

OCTOBER.

Light frosts Oct. 23, 26, 27, 28, 29. Killing frosts Oct. 2, 21, 26, 27, 28.—*Marquette.*

Frosts Oct. 2, 4, 5, 6, 21 and 26 to 31, inclusive.

Oct. 17, flock of geese on Gulliver Lake. Oct. 18, large flock of geese flying south. Oct. 26, ground first frozen. Temperature of Gulliver Lake Oct. 1st, 49°, 12th 55°, 15th 51°, 16th 44°, 26th 42°, 29th 42°. —*Gulliver Lake.*

Frosts Oct. 1, 2, 5, 21, 25, 26, 27, 29, 30. First killing frost on Oct, 1.—*Escanaba.*

Light frost Oct. 26, 31. Heavy frost Oct. 1, 5, 6, 27, 28, 29, 30.—*Mackinaw City.*

Heavy frost Oct. 1. Light frosts Oct. 2, 3, 6, 26, 27, 30, 31. Melting snow on ground Oct. 1 and 15.—*Alpena.*

Oct. 2, first killing frost of the season.—*Port Huron.*

Frosts Oct. 1, 2, 3, 16, 17, 27, 28, 30, 31, all slight. October was very dry, pleasant, warm month, the average temperature being 4° or 5° above normal. A month of nice weather for work but too dry for the growing wheat and for health. There is, as the month closes, no water in the swamps and wells are failing. Movements of migratory birds:—Flocks of robins were occasionally seen about the middle of the month, bluebirds nearly as late. Falling of leaves of deciduous trees:—Oct. 1, butternut nearly bare, Oct. 5, black ash, white thorn, Oct. 10, maple, elm, Oct. 25, locust; most other trees still partially retain their leaves.—*Thornville.*

Heavy frost Oct. 1, ice formed Oct. 3. Wild geese and swans flying southward Oct. 16 and 17.—*Hudson.*

First killing frost Oct. 3. Wild geese Oct. 17.—*Parkville.*

First snow of the season Oct. 1; heavy frost Oct. 2, killed tender plants; heavy frost Oct. 3; light frosts Oct. 21, 29, 31. Wild geese flying south Oct. 18.—*Lansing.*

Frost on nights of Sept. 1, 2, 15, 20, 29.—*East Saginaw.*

NOVEMBER.

Frosts Nov. 4, 11, 14, 15, 21, 26, 27, 28. Mean temperature of the lake 41°.—*Marquette.*

Last robins Nov. 4. First day on which average temperature was below 32°, Nov. 5; first day on

which maximum temperature was below 32°, Nov. 7.—Thin ice along shore of Gulliver Lake Nov. 12; Gulliver Lake frozen across in the morning, broke up in the afternoon, Nov. 14. First snow that could be measured Nov. 16. Gulliver Lake frozen across Nov. 20; ice in Gulliver Lake 3 inches thick; snow on ground 7½ inches deep Nov. 30.—*Gulliver Lake.*

Frosts Nov. 12, 13, 21.—*Escanaba.*

Heavy frost Nov. 9.—*Mackinaw City.*

Light frosts occurred Nov. 4, 6, 7, 8, 9, 14, 15, 16, 21, 22; heavy frost Nov. 6; melting snow on ground Nov. 18, 19, 23.—*Alpena.*

Frosts Nov. 6, 11, 12, 13, 14, 16, 21, 22, 30.—*Grand Haven.*

Black River froze over Nov. 27.—*Port Huron.*

Nights when it did not freeze, Nov. 1, 2, 5, 16, 22. November till the 17th was a continuation of the drought of preceding month. The heavy rain of the above date made little impression and the water on the top of the ground remains very low. Wells are failing beyond any precedent. Without more rain before winter we shall have a water famine. Snow fell on the 28th, that made sleighing. As usual, when the water is low there is considerable enteric fever.—*Thornville.*

Nov. 6, 7 A. M. Very slight snow on the ground, the first of the season.—*Ann Arbor.*

Winter set in on November 18.—*Parkville.*

White frost Nov. 4, 13, 15, 22; heavy white frost Nov. 7, 14, 22. Grand River frozen over Nov. 25.—*Lansing.*

DECEMBER.

White frost Nov. 4; heavy white frost Dec. 3, 18, 30.—*Lansing.*

Killing frosts Dec. 9, 16, 17, 22, 25, 30; light frosts Dec. 15, 18, 19, 27, 28, 29, 31.—*Marquette.*

Last line boat at Manistique for 1886, Steamer Van Ralte from Harbor Springs, Dec. 4. Melting snow on ground Dec. 10, 11, 12. Fishing tugs laid up, close of navigation, Dec. 18.—*Gulliver Lake.*

Heavy frosts Dec. 9, 15, 16, 17, 18, 25.—*Escanaba.*

Light frosts Dec. 4, 5, 9, 21, 27, 29; heavy frost Dec. 22, ground frozen 15 inches. River frozen Dec. 2, opened Dec. 7, and again closed Dec. 16.—*Alpena.*

Frosts Dec. 4, 5, 9, 17, 22, 23, 30.—*Grand Haven.*

Melting snow on ground Dec. 9, 10, 19, 21, 22. Month went out cold and blustery with about 12 inches of snow on ground.—*East Saginaw.*

Navigation closed on Lake Huron Dec. 12, 1886.—*Port Huron.*

Day on which it did not freeze, Dec. 10. Trees loaded with rime Dec. 9, 23. December has been a month of severe winter, with an average temperature about 9° below an average for the month for the last ten years. There were 12 days only that the mercury rose at any time during the day to this long mean, and four only with a mean equal to this long mean. Water is low almost beyond precedent. Stoned up wells are generally failing and swamps are entirely dry. Snow is deep (20 inches or more) and not yet much drifted. The snow is so light and dry that it does not pack and sleighing is poor.—*Thornville.*

Frosts Dec. 3, 4, 5, 6, 7, 9, 10, 22, 23, 25.—*Swartz Creek.*

MEASUREMENTS AND TEMPERATURE OF GROUND WATER.

In a paper entitled "Typhoid Fever and Low Water in Wells," on pages 89–114 of the report of this board for 1884, it is shown that for the years 1878–82 there was a relation between the sickness and deaths from typhoid fever in Michigan and the depth of water in wells. In the month of October, when the water in wells reached the lowest point in the year, there were the most deaths and sickness from typhoid fever; and following the month of April, when the water in wells was highest, there were the least deaths and sickness from typhoid fever. When this comparison is made in a diagram, it is found that, "beginning with June in each year the curve representing sickness from typhoid fever follows more or less closely the curve representing the average depth of earth above the ground water."

Typhoid fever being one of the most important causes of deaths in Michigan, it is of very great importance that further evidence be collected on this important subject.

The measurements, for each month in 1886, of the depth of wells, at six places in Michigan, are shown in Exhibit 4; also the depth of earth above water in wells and temperature of water in wells It is hoped these measurements and observations may continue, and permit a more extended comparison of the depth of water in wells with the sickness from typhoid fever, and with sickness and death from other diseases.

CHANGE OF EXPOSURE OF INSTRUMENTS AT LANSING IN 1884.

Comments on the subject of a new instrument shelter at Lansing are printed on page 21, Report for 1885. Exhibits A, B, C, and D, pages 22 and 23, of the Report for 1886, relate to that subject, and may be studied in connection with what is said on page 21, Report for 1885. The fact of the change of place of observation in 1884 may need to be taken into account by whoever studies the meteorology at Lansing through a long series of years.

EXHIBIT 4.—*Depth of Wells; Depth of Ground above Water in Well; Temperature of Water in Well, and Day of observation of such temperature, in each month of the Year 1886, as reported by Meteorological Observers for the State Board of Health, and for the United States Signal Service.*

Stations In Michigan.	January. Depth of Well.—Ft., In.	January. Depth of Ground above Water in Well.—Ft., In.	January. Temp. of Water in Well.—Deg. F.	February. Depth of Well.—Ft., In.	February. Depth of Ground above Water in Well.—Ft., In.	February. Temp. of Water in Well.—Deg. F.	March. Depth of Well.—Ft., In.	March. Depth of Ground above Water in Well.—Ft., In.	March. Temp. of Water in Well.—Deg. F.
Alpena	23 6	18 4	[16] 31 3	18	14 6	[18] 31 4	12	8 6	[17] 35 4
East Saginaw	14	3	[15] 44	14	1 4	[14] 41	14	2 10	[17] 40 5
Thornville	20	16 9	[15] 36	20	16 5	[15] 38	20	16 4	[15] 36
Lansing	26 11½	22 11⅞	[15] 49	26 11½	23 1½	[15] 47	26 11½	22 9⅝	[15] 46
Otsego	-----	-----	-----	-----	-----	-----	-----	-----	-----
Ann Arbor	15 2½	11 1	[17] 38	15 2½	11 1½	[15] 40 3	15 2½	12 2	[15] 40
Battle Creek	70	60	[15] 50	-----	-----	-----	-----	-----	-----
Hudson	17	6 6	[16] 39	17	7	[16] 36	-----	-----	-----
Kalamazoo	24	17	[14] 50	24	2	[19] 50	24	11 6	[17] 49
River Raisin	23	14 6	[16] 43	23	15	-----	23	15	[18] 43
Hillsdale	27	19	[15] 53	27	18 11	[15] 52	27	21 6	[15] 52

Stations In Michigan.	April. Depth of Well.—Ft., In.	April. Depth of Ground above Water in Well.—Ft., In.	April. Temp. of Water in Well.—Deg. F.	May. Depth of Well.—Ft., In.	May. Depth of Ground above Water in Well.—Ft., In.	May. Temp. of Water in Well.—Deg. F.	June. Depth of Well.—Ft., In.	June. Depth of Ground above Water in Well.—Ft., In.	June. Temp. of Water in Well.—Deg. F.
Alpena	8	3 4	[18] 39 3	7 6	3 4	[17] 50 3	8	6 6	[17] 53 2
East Saginaw	14	2 5¾	[18] 42	-----	-----	-----	-----	-----	-----
Thornville	20	16	[15] 43	20	15 9	[16] 45	20	15 11	[17] 47
Lansing	26 11½	22 7⅝	[16] 45	26 11½	22 8⅞	[17] 46	26 11½	23 1	[16] 46
Otsego	17	13 3	[30] -----	18	14 5	[18] -----	18	15	[15] -----
Ann Arbor	15 2½	8 8	[15] 38	15 2½	12 5½	[17] 43	15 2½	12 9½	[16] 48
Battle Creek	-----	-----	-----	-----	-----	-----	-----	-----	-----
Hudson	17	5	[18] 37	17	6	[16] 45	-----	-----	-----
Kalamazoo	24	21	[23] 50	24	20	[16] 50	24	17	[17] 50
River Raisin	23	15	[16] 50	23	14	[16] 48	23	15	-----
Hillsdale	30	18	[15] 50	30	22 10	[15] 50	30	22 2	[15] 52

NOTE.—The small figures above and at the right of the numbers denoting the degrees of temperature, state the day of the month on which the observation was made.

EXHIBIT 4.—*Continued.*

Stations in Michigan.	July.			August.			September.			October.			November.			December.		
	Depth of Well.—Ft., In.	Depth of Ground above Water in Well.—Ft., In.	Temp. of Water in Well.—Deg. F.	Depth of Well.—Ft., In.	Depth of Ground above Water in Well.—Ft., In.	Temp. of Water in Well.—Deg. F.	Depth of Well.—Ft., In.	Depth of Ground above Water in Well.—Ft., In.	Temp. of Water in Well.—Deg. F.	Depth of Well.—Ft., In.	Depth of Ground above Water in Well.—Ft., In.	Temp. of Water in Well.—Deg. F.	Depth of Well.—Ft., In.	Depth of Ground above Water in Well.—Ft., In.	Temp. of Water in Well.—Deg. F.	Depth of Well.—Ft., In.	Depth of Ground above Water in Well.—Ft., In.	Temp. of Water in Well.—Deg. F.
Traverse City*	......	......	......	55	37 4	[18] 46	55	37 8	[22] 48	......	......	......	55	36 8	[24] 50	55	36 4	[29] 50
Alpena	8	5 3	[19] 55 2	8	6	[18] 49 6	8	5 9	[18] 50 8	8	5 8	[16] 50	8	5 1	[17] 32 3	8	5 2	[14] 31 8
Bay Port	......	......	......	......	......	......	14	5	[22] 54	15	4	[22] 54	15	4	[18] 44	10	5	[18] 41
Thornville	20	16 1	[16] 49	20	17 5	[17] 50	20	17 5	[17] 50	20	17 7	[18] 48	20	17 10	[16] 46	20	18	[18] 40
Lansing	26 11½	23 6¼	[16] 47 [16]	26 11½	23 10½	[16] 50 [15]	26 11½	23 10½	[15] 52 [15]	26 11½	23 10⅜	[16] 52 [15]	26 11½	24 2⅞	[15] 51 [15]	26 11½	24 6	[16] 50
Otsego	18	14 11	......	16	13 6	......	17	14 8	......	17	15 2	......	17	14 8	......	17	14 11	......
Ann Arbor	15 2½	13 6½	[21] 52	15 2½	13 10½	[6] 56 7	15 2½	14 3½	[21] 55	15 2½	14 5	[16] 54 5	15 2½	14 7½	[26] 46	15 2½	14 8½	[15] 45
Battle Creek	......	......	......	80	70	[19] 53	......	......	......	50	46	[28] 52	50	46	[20] 54	......	......	......
Hudson	17	14	[16] 51	11	9 6	[15] 53	11	9	[16] 54	......	......	......	......	......	......	......	......	......
Kalamazoo	25 †	9	[15] 52	25 ††	9 6	[14] 54	24	21 6	[15] 52	26	9 6	[16] 50 [14]	25	10	[15] 50 [15]	25	10	[15] 48
River Raisin §	23	15 6	[15] 50	23	15	[14] 53	23	16 6	[14] 52	23	17 6	......	23	17	......	23	17 6	[16] 42
Hillsdale	30	22 10	[18] 52	30	23 11	[15] 53	30	24 10	[15] 52	......	......	......	30	25 8½	[15] 50	30	26	[15] 50

NOTE—The small figures above and at the right of the numbers denoting the degrees of temperature, state the day of the month on which the observation was made.

* At Northern Michigan Asylum, W. H. Bauld, Observer.

† This well fills up at night and is pumped out during the day, so that the depth of earth above the water varies continually.—Register for July, 1886.

†† This well fills up to 16½ ft. during the night and is pumped out to one foot during the following day. Soil dry for the last three months.—Register for August, 1886.

§ D. W. Palmer, Observer.

TEMPERATURE.

Compared with the average for the preceding 22 years at the Agricultural College the mean temperature for December was low. A comparison, by months, of temperature in 1886, with the averages for corresponding months in the preceding 22 years, 1864–85, at the Agricultural College, near Lansing, is given in Exhibit 6, page 45.

The average temperature, by months, for the 8 years, 1879–86, at Lansing, and a comparison of 1885, by months, with that average, are stated in Exhibit 7, page 45.

The average annual and monthly temperature at from 12 to 22 stations for a period of 10 years, 1877–86, is stated in Exhibit 5, page 33, in which is also given, by months, a comparison of 1886 with the average for 1885, and with the average for the 10 years, 1877–86. By Exhibit 5, page 33, which gives averages for groups of several stations in Michigan, it appears that in 1886 the mean temperature in July, November and December was lower than in those months in 1885. It also appears that December was much colder than the average temperature of the corresponding month for the 10 years 1877-86, and April and October slightly warmer than the average temperature of the corresponding months for those years.

By Exhibit 10, page 50, it appears that, at the Agricultural College, the lowest temperature reached in February and December, 1886, was considerably below the average lowest temperature for the preceding 13 years, and that in the months of February and November, 1886, the range of temperature was much greater than the average range of temperature for the corresponding month in the 13 preceding years, and also the highest and lowest temperatures for 1886 were below the average highest and lowest for those years. The highest and lowest temperatures at the Agricultural College in every month of the 14 years, 1873–86, and comparisons of months in 1886, with the average highest and lowest temperatures by months for the preceding 13 years, are stated in Exhibit 10, page 52.

The average temperatures at each of 17 stations in Michigan, and the average for the 17 stations in 1886, and in each month of that year, are stated in Table I, page 47; 7 of the lines in this table are represented in Diagram I., page 46.

The average daily range of temperature at from 6 to 18 stations per year, by months, for a period of 8 years, 1879-86, and a comparison of 1886 with the monthly averages for that period and for 1885, are given in Exhibit 8, page 52. The highest and lowest temperatures in every month in 1886, at each of 18 stations, are stated in Table II, pages 48 and 49. The average daily range of temperature by months in 1886, at each of 18 stations, and the average for the 18 stations, are stated in Table III, page 53. The lines for 8 of these stations are represented in Diagram II, page 51. It will be noticed that the greatest average daily range occurred during the months of April, May, June, July and August.

EXHIBIT 6.—*Comparison of the Average Temperature during the Year and during each month of the Year, 1886, with the Annual and with the Monthly Averages for the Year 1885, and with the Averages for the 22 Years, 1864-85. Observations made by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Michigan.*

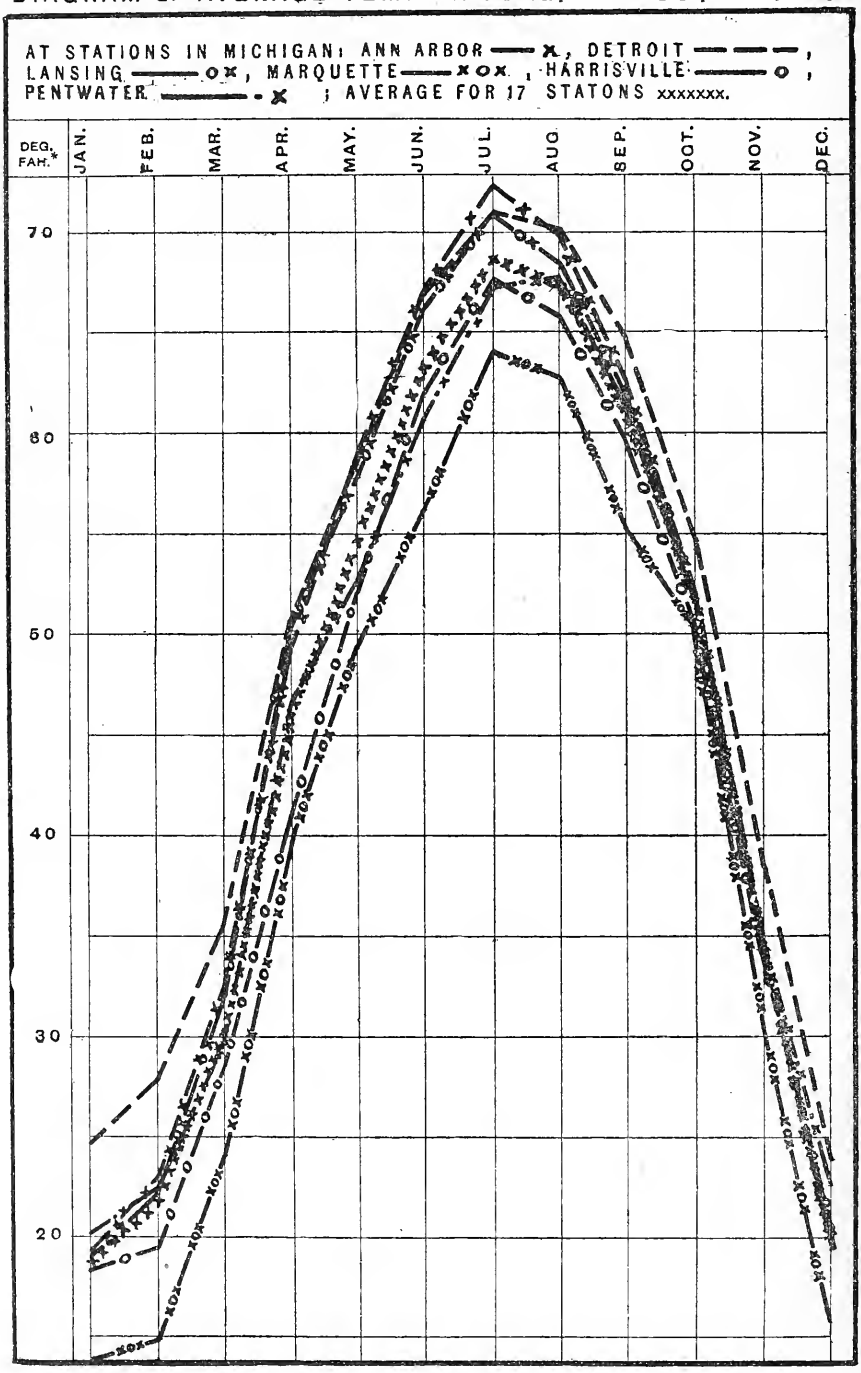
Years, Etc.	Average Temperature.—Degrees Fahr.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 22 yrs, 1864-85	46.47	21.79	23.81	31.06	45.52	58.10	67.74	71.51	68.78	60.33	48.29	35.36	25.48
1885	42.90	15.34	8.94	21.26	43.59	55.76	64.69	72.70	63.62	58.94	44.95	37.22	27.75
1886	46.20	18.78	22.27	31.33	50.18	58.06	65.72	70.68	69.30	62.07	52.37	33.94	19.74
In 1886 **Higher** than Av. for 22 yrs. 1864-85	.....	.....	.....	0.27	4.66	.....	.....	.....	0.52	1.74	4.08	.....	.....
In 1886 **Lower** than Av. for 22 yrs, 1864-85	0.27	3.01	1.54	.....	.....	0.04	2.02	0.83	.....	.....	.....	1.42	5.74
In 1886 **Higher** than in 1885	3.30	3.44	13.33	10.07	6.59	2.30	1.03	.....	5.68	3.13	7.42	.....	.....
In 1886 **Lower** than in 1885	.....	.....	.....	.....	.....	.....	.....	2.02	.....	.....	.....	3.28	8.01

EXHIBIT 7.—*Average Temperature,* by Year and Months, for the 8 Years, 1879-86. Observations made at Office State Board of Health, State Capitol, Lansing, Michigan.*

Years, Etc.	Average Temperature.—Degrees Fahr.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 8 years, 1879-86	47.37	21.20	23.89	31.39	46.11	58.92	67.39	72.49	69.39	62.42	52.05	36.70	26.47
1885	43.01	15.85	10.49	21.57	43.97	55.71	65.26	73.35	63.28	55.86	45.43	38.21	27.14
1886	46.19	19.02	22.44	32.09	50.16	57.77	66.20	70.87	68.49	61.81	51.78	34.02	19.61
In 1886 **Higher** than Av. for 8 yrs., 1879-86	.....	.....	.....	0.70	4.05	.....	.....	.....	.....	.....	.....	.....	.....
In 1886 **Lower** than Av. for 8 yrs, 1879-86	1.18	2.18	1.45	.....	.....	1.15	1.19	1.62	0.90	0.61	0.27	2.68	6.86
In 1886 **Higher** than in 1885	3.18	3.17	11.95	10.52	6.19	2.06	0.94	.....	5.21	5.95	6.35	.....	.....
In 1886 **Lower** than in 1885	.....	.....	.....	.....	.....	.....	.....	2.48	.....	.....	.....	4.19	7.53

* Beginning with the year 1885, slight allowance should be made for Lansing in Exhibit 7, because of a change in the location of the instruments. The amount of the variation by months is shown in Exhibit A, on page 22, Report for 1886.

DIAGRAM I.—AVERAGE TEMPERATURE, BY MOS., IN 1886.



*SCALE, 10° F. TO 1.08 IN. VERTICALLY.

H. B. T. DEL. DES. BY H. B. B.

TABLE I.—*Average Temperature in Degrees Fahr., for the Year, and for each Month of the Year 1886, at each of 17 Stations in Michigan, and also the Average for the 17 Stations. From Observations made Daily at 7 A. M., 2 P. M. and 9 P. M.,* by Observers† for the State Board of Health, and for the U. S. Signal Service.*

Stations in Michigan.† (Those of the U. S. Signal Service in Italics.)	Division of the State.‡	Temperature in Degrees Fahr.												
		Year.		Months, ¶ 1886.										
		Norm. ‖	1886.	Jan.	Feb.	Mar.	Apr.	May.	J'ne.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 17 stations §	.....	.....	44.82	18.72	21.18	30.10	46.04	54.69	63.31	68.68	67.39	61.15	51.84	34.32	20.44
Marquette	U. P.	.....	39.73	13.80	14.90	24.10	39.90	49.40	56.20	64.10	62.80	55.10	50.30	30.40	15.70
Manistique and Gulliver Lake D	U. P.	 15	41.14	17.18	19.21	28.33	39.63	50.16	58.44	66.43	64.22	55.36	47.75	30.23	16.77
Escanaba	U. P.	40.34 4	39.69	12.80	14.50	24.40	38.00	50.00	60.00	65.50	62.80	55.00	48.20	30.10 b	15.00
Traverse City	N. W.	42.13 3	43.79	18.90	19.43	27.57	43.18	52.59	62.18	67.95	67.33	59 77	51.72	33.31	21.56
Mackinaw City	N.	40.08 14	41.55	15.00	17.30	26.50	38.00	49.90	58.20	65.40	63.60	57.20	50.30	34.60	22.60
Alpena	N. E.	41.17 2	40.55	15.40	16.00	25.50	38.10	49.60	58.50	64.40	62.80	56.00	48.10	32.00	19.90
Harrisville	N. E.	42.15 15	43.28	18.35	19.50	28.54	41.11	52.12	61.89	67.59	65.70	59.70	50.51	34.11	20.20
Grand Haven	W.	46.62	44.91	20.20	23.10	30.40	47.30	52.20	61.00	65.90	67.10	61.50	52.30	35.40	22.50
Muskegon	W.	.....	46.51	19.85	22.86	31.42	49.96	56.11	65.40	70.02	69.31	63.10	53.31	35.39	21.40 b
Pentwater	W.	.....	44.80	20.10 b	22.54	29.84	46.61 f	52.61	60.62 b	67.15 b	67.67	61.38	51.67	34.77	22.61
Reed City	W.	.....	‡‡	17.45	18.79	26.60	46.16	55.60 a	64.37 e	67.69 b	..... f	.....	..... b	.....	.....
Port Austin	B. & E.	 12	§§	20.62	21.24	28.67	43.64	51,88	62.02	66.92	66.17	61.24	52.55	.....	.....
Port Huron	B. & E.	44.96 10	44.33	19.90	21.30	30.40	44.20	51.40	61.70	67.10	66.40	61.40	52.30	35.50	20.30
Thornville	B. & E.	47.80 23	48.02	20.39	22.96	32.85	50.78	59.25	67.57	71.53	70.45	70.45	54.06	35.89	20.01
Agr'l College (near Lansing)	C.	46.45	46.20	18.78	22.27	31.33	50.18	58.06	65.72	70.68	69.30	62.07	52.37	33.94	19.74
Ionia	C.	 8	‖ ‖	20.09	23.40	31.54	51.22	.....	.....	72.47	71.51	63.06	54.47	35.09	20.97
Lansing, S. B. of Health **	C.	47.37 8	46.19	19.02	22.44	32.09	50.16	57.77	66.20	70.87	68.49	61.81	51.78	34.02	19.61
Swartz Creek	C.	44.60	45.66	19.81	21.53	31.29	49.00	57.46	65.98	69.71	68.34	62.07	51.01	33.53	18.23
Otsego	S. W.	 6	A	.....	22.54 d	31.03	51.96	59.24	68.64	72.83 b	70.90 d	62.38	50.41	32.11	18.08 b
Ann Arbor	S. C.	45.89	46.76	19.31 a	23.10	32.50	49.40	59.00	67.20	72.40	69.80	62.60	52.10	34.40	19.30 a
Battle Creek	S. C.	 10	B	22.92	26.86	.....	55.33	63.20	71.07	75.59	71.97	.....	56.36	37.87	24.88
Kalamazoo	S. C.	47.59 4	47.46	20.23	24.10	33.68	52.16	59.51	67.66	71.47	70 04	62.97	53.23	34.43	20.00
Marshall	S. C.	47.68	49.29	21.47 a	25.77 d	35.06	53.06 c	61.79 a	69.51 b	74.55	71.81	64.62	54.17 d	36.64 c	23.08 c
Birmingham	S. E.	 15	C	19.38	21.72	31.70	50.33	57.64	65.75	.....	.....	.....	51.44	34.54	18.72
Detroit	S. E.	48.33	48.95	24.70	28 00	35.60	50.60	58.40	66.80	71.00	70.20	64.80	54.80	38.50	24.00

a, b, c. In the columns from January to December, inclusive, the letters a, b, c, etc., stand directly above the numbers from which they refer to the notes below.

a For 30 days. b For 29 days. c For 28 days. d For 27 days. e For 26 days. f For 23 days.

* At the U. S. Signal Service Stations for the year 1886, the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th meridian time, and one-third the sum of the three observations was taken as the daily average. The local time at these stations corresponding to 7 A. M., 3 P. M., and 11 P. M., 75th meridian time, is as follows: At Port Huron, 6:30 A. M., 2:30 P. M., and 10:30 P. M.; at Detroit, 6:28 A. M., 2:28 P. M., and 10:28 P. M.; at Alpena, 6:26 A. M., 2:26 P. M., and 10:26 P. M.; at Grand Haven, 6:15 A. M., 2:15 P. M., and 10:15 P. M.; at Mackinaw City, 6:22 A. M., 2:22 P. M., and 10:22 P. M.; at Escanaba, 6:12 A. M., 2:12 P. M., and 10:12 P. M.; at Marquette, 6:11 A. M., 2:11 P. M., and 10:11 P. M. At the other stations the observations were made at 7 A. M., 2 P. M., and 9 P. M., local time; and the daily averages were one-third the sum of these three observations.

† The names of observers, their place of observation, and the counties in which these places are situated, are stated in Exhibit 1, page 30.

‡ The names of divisions, and the counties in each are stated in Exhibit I., in a paper which follows on weekly reports of sickness.

§, ‖, ¶, **, ‡‡, D. See page 49.

TABLE II.—*Extremes of Temperature and Days of Month on which the Highest and for the Year 1886, at each of 18 Stations in Michigan.—As indicated by Daily Readings P. M., by Observers* for the State Board of Health, and for the U. S. Signal Service.*

Line Number.	Stations in Michigan.* (Those of the U. S. Signal Service in Italics.)	Year 1886.			January.		February.		March.		April.		May.	
		Highest.	Lowest.	Range.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1	At 18 Stations.....†	101	-30	131	55	-22	54	-30	73	-25	84	0	88	22
2	*Marquette*.....§	98	-18	116	35 14	-18 23	51 8	-14 3	52 26	-3 13	79 19,30	7 7	87 23	28 6
3	Manistique and Gulliver Lake..†‡‡	----	----	------	42 1	-22 24	56 8	-28 3,4	61 25	-10 1	70 19	0 4	81 19	26 7
4	*Escanaba*.....§	86	-22	108	35 3,4	-22 22	38 10	-19 3,4	47 17	-7 9	62 22	0 3	80 22	26 6
5	Traverse City.....‡	101	-30	131	41 4	-13 23	50 7	-30 4	52 24	-25 1	82 19	4 4	85 22	29 7,8
6	*Mackinaw City*....§	93	-19	112	41 4	-16 23	45 25	-19 6	45 25	-5 1	67 23	10 3	76 29	33 7
7	*Alpena*.....§	98	-23	121	45 4	-11 22	42 8	-23 4	48 12	-5 9	79 23	12 2	83 29	31 7
8	Harrisville.....‡	98	-27	125	51 4	-21 22	49 9	-27 3	49 19	-2 1	78 16	5 3	85 12	29 7
9	*Grand Haven*.....§	87	-15	102	50 3	-1 7	49 10	-15 3	62 19	5 2	77 16	19 3	78 12	35 16
10	Muskegon.....**	----	----	------	43 3	0 27	46 9	-19 2	59 24	2 1	79 16	18 2	80 21	39 6
11	Pentwater.....‡	95	-26	121	49 3	-5 22	54 10	-26 3,4	60 17	-3 1,2	79 21,22,23	3 2	81 21	22 6
12	Reed City.....‡	----	----	------	44 4	-18 23	50 11	-29 6	52 17	-4 1	80 23	6 3	88 22	25 17
13	East Saginaw.....‡	96	-20	116	51 4	-7 23	53 11	-20 4	58 25	5 1	83 23	18 3	88 29	33 7
14	Port Austin.....**	----	----	------	46 4	-7 23,24	46 11	0 5	47 19	3 1	83 23	18 4	80 22	38 16
15	*Port Huron*.....§	91	-13	104	49 3	-5 23	49 11	-13 3	53 19	2 2	79 23	19 4	81 22	33 16,17
16	Thornville.....‡	96	-12	108	48 4	-6 22,23	49 12	-11 4	54 19	6 1,2	83 23	18 2	84 22	36 16
17	Agr'l College.....‡	93	-18	111	50 6	-12 23	52 12	-18 6	65 20	5 1	80 23	16 3	83	34
18	Ionia.....‡	----	----	------	54 3	-8 23	48 11	-16 4	56 19	6 1	80 23	18 2	22	16
19	Lansing, State B. of H.....‖‡	94	-18	112	50 3	-12 23	51 11,25	-18 4	67 19	5 1	80 23	16 7	82 22	33 16
20	Swartz Creek.....‡	95	-27	122	50	-15	49 11	-27 3	59 19	5 1	81 23	14 2	83 22	32 16
21	Otsego.....**	----	----	------	4	23	55 9	-29 5	70 19	6 2	80 23	18 3	80 22	35 8
22	Ann Arbor.....¶	96	-10	106	49 3	-8 22	49 23	-10 4	63	6	80 21	19 2	83 22	36 16,17,18
23	Battle Creek.....‡	----	----	------	52 3	-13 22	57 11	-14 4	19	1	96 23	18 7	93 22	34 7,16
24	Hudson.....‡	96	-26	122	49 3	-17 22	52 11	-26 2,3,4	73 19	5 1	83 23	12 2	87 22	33 15,16
25	Kalamazoo.....‡	92	-14	106	52 3	-14 22	51 11	-9 4	68 19	7 1	81 23	19 2	82 22	37 16
26	Marshall.....‡	95	-13	108	52 3	-13 22	52 11	-13 4	69 19	7 1	84 22,23	18 7	85 22	35 7
27	Birmingham.....‡	----	----	------	49 4	-11 11	45 11	-20 5	54 15	4 1	80 23	17 4,5	87 22	32 8,17
28	*Detroit*.....§	92	-4	96	55	-4	54	-3	61	6	82	23	83	40

Foot-notes from page 47.]

§ This line is an average for only the 17 stations from which statements nearly complete were received for every month of the year. It does not include Manistique and Gulliver Lake, Reed City, Port Austin, Ionia, Swartz Creek, Otsego, Battle Creek, and Birmingham.

‖ Numbers in this column state the average annual temperature for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the temperature, denote the number of years included in the average.

¶ The computations of Av. Temp., as tabulated for months in 1886, were made at the following stations: Marquette, Escanaba, Mackinaw City, Grand Haven, Detroit, Ann Arbor, Alpena, and Port Huron. All other computations in Table I. were made at the office of the Secretary of State and the State Board of Health.

** Beginning with the year 1885, allowance must be made for Lansing in Table I., because of a change in location of instruments. The amount of the variation by months is shown in Exhibit A., page 22, Report for 1886.

‡‡ The average for 7 months in 1886 is 42.38. §§ For 10 months, 47.50. ‖‖ For 10 months, 44.38. A for 11 months. 49.11. B For 10 months, 50.61. C For 9 months, 39.02.

D The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer with the same instrument at Gulliver Lake. Gulliver Lake is about 12 miles east from Manistique.

The lines for 6 representative stations in Table I. are graphically represented in Diagram I. page 46.

the Lowest Temperature occurred by Months of the Year 1886; also, Extremes and Range of Registering Thermometers, or by Observations made Daily at 7 A. M., 2 P. M. and 9

June.		July.		August.		September.		October.		November.		December.		Line Number.
Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	
95	27	101	33	98	32	91	27	83	16	72	-15	53	-22	1
13	7,8	5	17	9	3	6	30	7	27	1,2	30	9,10	27	
87	39	97	38	98	42	90	33	80	27	69	9	42	-13	2
14	5,7	6	17,21	27	31	4,5	20,30	8,9,10	26	2	29	9	31	
84	34	88	45	89	41	78	32	69	23	61	1	43	-17	3
29	3,6	6	22	27	31	7	30	8	26	1	28	9,10	27	
86	38	86	44	80	42	76	33	71	24	57	5	39	-15	4
15	7	6	14	9	31	6	30	10	26	1	29	10	30	
90	34	101	44	95	43	91	34	81	27	70	3	46	-1	5
13	6	5	12	9	4,18	6,7	21,30	8	27	2	29	10	29	
82	39	92	46	93	46	87	36	77	28	72	12	46	0	6
13	18	6	12	27	4	7	21	8	16,27	1	30	10	30	
84	41	98	43	90	44	85	33	78	29	67	11	53	-2	7
13	b	6	11	10	31	25	30	8	1	1	27,29	10	26	
85	33	98	39	91	34	84	27	78	27	62	10	50	-10	8
12	8	5	19	12	3	3	30	13,14	26	2	30	11	30	
80	44	87	46	86	46	82	40	73	28	69	6	49	-3	9
15	3	6	18	12	12	7	14,30	9	30	2	30	11,12	4	
88	49	92	53	90	50	88	45	77	29	68	4	46	-2	10
16	7	6	18,21	9	31	6,7	20	10	26	1,2	29	9,10	29	
93	27	95	33	93	32	89	33	83	16	67	-15	48	-22	11
14,15	7													
94	31													12
15	8	6	12	27	6	6,7	21	13	16	1,2	30	10	6	
94	42	96	42	91	43	87	36	81	31	71	11	50	-6	13
18	3	6	22	8,9	6	4,26	14,21							
81	47	92	54	88	49	82	40 a							14
16	8	6	12	27	3	8	13	12	2	1	7	10	28	
86	42	91	46	87	45	90	38	78	31	67	17	46	-2	15
15	8	6	22	27,29	3	8	21	13	16	1	29	10	26	
92	44	96	50	92	49	90	39	79	34	70	9	47	-12	16
15	17	6	21	11,27	31	6,7,8	30	13	30	1	29	11	4	
90	41	93	45	91	37	87	35	80	30	70	3	50	-13	17
15	7	6	21	27	31	8	30	13	15,16,28	1,2	29,30	11	29	
91	40	94	46	89	38	86	36	79	31	68	5	50	-10	18
		25,26,27	22	10	3	8	18,14	13,14	26	3	30	11	6	
		95	48	91	46	88	39	78	32	66	4	46	-8	19
14,15	7	26	21	27	31	8	20,30	12	30	1	29	12	4	
91	37	95	43	91	34	89	34	78	27	70	-2	47	-14	20
15	18	25	14,18	28	31	6	30	4,9,11	3	1,4	13	11	4	
93	45	93	58	91	48	90	38	76	30	60	16	49	-13	21
16	18	6	19	28	31	8	30	11,12,13	16,27	2	30	10	17	
92	45	96	51	90	50	86	41	75	33	66	13	45	-2	22
14	7	6	18	27	2			13	26,28	1	29			
95	42	95	49	93	45			81	32 b	68	8			23
15	3	6	22	28	31	8	30	13	1,2	2	29	11	16	
95	37	96	45	92	36	88	32	81	28	70	10	49	-13	24
15	2,7	6	19	9	31	8	20,30	13	27	1,2	30	11	6	
92	46	92	51	89	51	84	42	78	34	67	11	50	-4	25
14,15	3	6	20	28	31	8	30	13	28,30	2	29	11	4	
95	43	95	50	92	41	88	38	80	32	68	8	51	-8	26
16	7							12,13	1	1,2	29	10	26	
91	38							76	28	66	5	43	-9	27
15	8,18	29	18	11	3	8	30	12	16,26,27	1,2	29	10	28	
89	49	92	53	89	52	85	43	77	36	65	22	52	3	28

NOTE.—The small figures above and at the right of numbers denoting the degrees of temperature, state the day or days of the month on which the highest or the lowest temperature occurred.

*The names of observers, etc., are stated in Exhibit 1, page 30.

†The line No. 1, and the three columns for the year 1886, relate only to the 18 stations from which observations were received for every month of the year. It does not include Manistique and Gulliver Lake, Muskegon, Reed City, Port Austin, Ionia, Swartz Creek, Otsego, Battle Creek or Birmingham.

‡For stations marked thus ‡, the daily readings of registering thermometers were recorded at 7 A. M. for the preceding calendar day.

§At the stations of the U. S. Signal Service the observations with registering themometers were read and recorded at 11 P. M.

¶At Ann Arbor the registering thermometers were read and recorded at 9 P. M.

‖Beginning with the year 1885 allowance must be made for Lansing in Table II, because of a change in the location of the instruments. The amount of the variation by months is shown in Exhibit B, on page 22, Report for 1886.

**At Muskegon, Port Austin and Otsego the highest and lowest temperatures were obtained from the tri-daily readings of the dry bulb of psychrometer.

‡‡The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer with the same instruments at Gulliver Lake. Gulliver Lake is about 12 miles east from Manistique.

[a] Also on Sept. 22, 23, 24 and 28.

[b] Also on Oct. 29 and 30.

EXHIBIT 10.—*Comparisons of the Extremes and the Range of Temperature (Degrees Fahr.) during the Year, and during each month of the Year 1886, with the Average of the Extremes, and of the Range, for the Thirteen Years, 1873-85; also, Statement of the Extremes and of the Range for each of the Thirteen Years, 1873-85. Observations made with Registering Thermometers (except for the first two months of 1873, and for those two months with an ordinary Thermometer, at 7 A. M., 2 P. M. and 9 P. M.) Daily, by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Mich. For Nov. and Dec., 1879, the observations were made by Harry B. Turner, at the Office of the State Board of Health, Lansing.*

Extremes and Ranges of Temperature.—Degrees F.

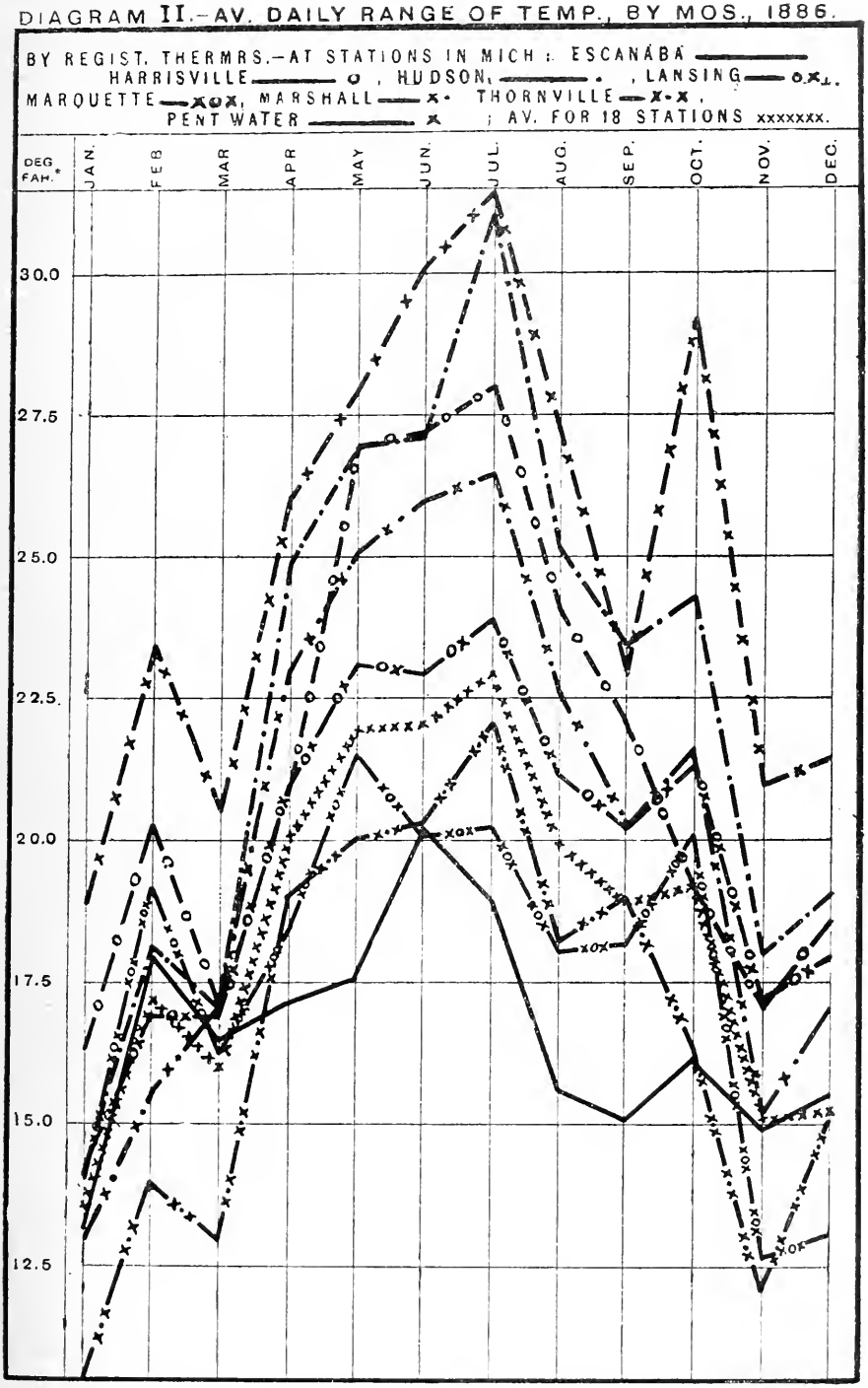
Years and Months.	1873.			1874.			1875.			1876.			1877.		
	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.
Year..	94	-30	124	101	-7	108	94	-33	127	96	-19	115	93	-14	107
Av. Month.	74	15	59	77	15	62	75	10	64	74	19	56	74	20	54
Jan....	43	-30	73	59	-7	66	35	-13	48	65	6	59	52	-9	61
Feb....	49	-13	62	48	-1	49	42	-33	75	59	-1	60	56	10	46
March.	57	-12	69	67	8	59	75	-11	86	60	0	60	51	-14	65
April..	82	24	58	68	3	65	80	0	80	74	16	58	81	18	63
May...	84	27	57	96	21	75	89	24	65	89	31	58	90	26	64
June..	94	42	52	95	34	61	89	33	56	95	42	53	89	40	49
July...	92	44	48	98	43	55	92	44	48	96	46	50	91	43	48
Aug...	94	44	50	101	41	60	93	35	58	96	36	60	93	43	50
Sept...	89	26	63	95	30	65	94	26	68	80	36	44	85	38	47
Oct....	79	16	63	76	16	60	77	18	59	75	19	56	87	26	61
Nov....	56	1	55	70	3	67	60	2	58	62	12	50	55	4	51
Dec....	64	10	54	50	-6	56	70	-1	71	41	-19	60	58	13	45

Years and Months.	1878.			1879.			1880.			1881.			1882.		
	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.
Year..	98	-7	105	97	-18	115	94	-17	111	100	-17	117	89	-10	99
Av. Month.	73	22	51	76	15	61	74	20	54	73	22	52	72	23	49
Jan....	48	-4	52	44	-18	62	62	9	53	37	-9	46	50	-2	52
Feb....	55	-7	62	41	-6	47	59	-2	61	48	-17	65	57	12	45
March.	72	18	54	66	4	62	55	6	49	50	9	41	66	16	50
April..	75	29	46	81	12	69	76	20	56	83	9	74	73	21	52
May...	77	29	48	91	25	66	87	40	47	89	33	56	79	28	51
June..	94	39	55	95	33	62	92	41	51	86	40	46	87	44	43
July...	98	47	51	97	47	50	94	50	44	95	52	43	89	47	42
Aug...	93	42	51	96	34	62	88	43	45	100	46	54	89	49	40
Sept...	92	31	61	85	27	58	88	30	58	97	43	54	85	32	53
Oct....	82	21	61	87	15	72	76	24	52	75	30	45	77	24	53
Nov....	52	15	37	75	13	62	62	-4	66	64	12	52	70	14	56
Dec....	36	-2	38	58	-3	61	47	-17	64	56	12	44	40	-10	50

Years and Months.	1883.			1884.			1885.			Av. for 13 years, 1873-85.			1886.*			1886 Higher (+), or lower (-), than Av. 13 yrs, 1873-85		
	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.	Highest.	Lowest.	Range.
Year..	91	-20	111	90	-25	115	90	-24	114	94	-19	113	93	-18	111	-1	+1	-2
Av. Month.	71	14	57	71	14	58	68	15	53	73	17	56	74	17	57	+1	=	+1
Jan....	41	-19	60	44	-22	66	42	-22	64	48	-11	59	50	-12	62	+2	-1	+3
Feb....	50	-20	70	52	-18	70	45	-24	69	51	-9	60	52	-18	70	+1	-9	+10
March.	52	-8	60	57	-13	70	44	-13	57	59	-1	60	65	5	60	+6	+6	=
April..	83	14	69	74	21	53	81	17	64	78	16	62	80	16	64	+2	=	+2
May...	80	31	49	80	28	52	85	26	59	86	28	58	83	34	49	-3	+6	-9
June..	87	42	45	89	43	46	86	40	46	91	39	52	90	41	49	-1	+2	-3
July...	90	45	45	89	44	45	90	47	43	93	46	47	93	45	48	=	-1	+1
Aug...	91	32	59	90	36	54	84	42	42	93	40	53	91	37	54	-2	-3	+1
Sept...	86	28	58	89	36	53	80	35	45	88	32	56	87	35	52	-1	+3	-4
Oct....	77	22	55	81	22	59	72	17	55	79	21	58	80	30	50	+1	+9	-8
Nov....	63	7	56	59	10	49	62	21	41	62	8	54	70	3	67	+8	-5	+13
Dec....	55	-2	57	53	-25	78	48	-7	55	52	-4	56	50	-13	63	-2	-9	+7

* For the fourteen years, 1873-86, the highest temperature was 101°, August 11, 1874; the lowest was -33°, February 8, 1875, and the range was 134°, F.

DIAGRAM II.—AV. DAILY RANGE OF TEMP., BY MOS., 1886.



*SCALE, 5° F. RANGE TO 1.53 IN. VERTICALLY.

H. B., T., DEL

DES. BY H. B. B.

EXHIBIT 8.—*Average Daily Range of Temperature, by year and months in 1886, compared with Annual and Monthly Averages for the 8 years, 1879–86. These Averages are for Groups of several Stations in Michigan.**

Years, Etc.	Average Daily Range of Temperature.—Degrees Fahr.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 8 yrs., 1879-86*..	18.29	16.34	18.23	18.02	19.41	20.83	20.62	20.50	19.84	19.74	17.69	14.69	13.56
1885—(18 stations*)..	18.78	17.03	22.94	22.22	18.25	19.72	22.73	22.09	18.45	20.42	16.81	11.53	13.19
1886—(18 stations*)..	18.53	13.65	17.40	15.93	20.11	21.87	22.02	22.94	19.77	18.83	19.31	15.11	15.44
In 1886 **Greater** than Av. for 8 yrs., 1879-86*	0.24	.....	.....	.....	0.70	1.04	1.40	2.44	.....	.....	1.62	0.42	1.88
In 1886 **Less** than Av. for 8 yrs., 1879-86*	.....	2.69	0.83	2.09	.....	.....	.....	.....	0.07	0.91	.....	.....	.....
In 1886 **Greater** than in 1885	.....	.....	.....	.....	1.86	2.15	.....	0.85	1.32	.....	2.50	3.58	2.25
In 1886 **Less** than in 1885	0.25	3.38	5.54	6.29	.....	.....	0.71	.....	.....	1.59	.....	.....	.....

* Marquette for 1879-84 and 1886; Grand Haven, Lansing, Detroit for 1879-86; Otisville for 1879-80 and 1882; Battle Creek for 1879-80; Escanaba, Alpena, Port Huron, Thornville for 1880-86; Kalamazoo for 1880-83 and 1886; Adrian for 1880; Agricultural College for 1881-6; Traverse City and Marshall for 1882-6; Harrisville for 1882 and 1885-6; Reed City for 1882 and 1884-5; Ann Arbor for 1882-3 and 1885-6; Washington for 1882-3; Winfield for 1883; Tecumseh for 1883-5; Manistique, Ionia, Swartz Creek for 1884-5; Mackinaw City for 1884-6; Hillsdale for 1884; Pentwater, East Saginaw, Hudson for 1886.

EXHIBIT 9.—*Comparisons of the Average Daily Range of Temperature for the Year and for each Month of the Year 1886, with Averages for the 12 years, 1874–85, and for the Year 1885. Observations made with Registering Thermometers by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Michigan.*

Years, Etc.	Average Daily Range of Temperature.—Degrees Fahr.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 12 yrs., 1874-85*.	21.03	16.96	19.44	19.46	22.61	24.82	23.51	24.78	25.63	24.18	20.34	15.95	14.63
1885	19.36	17.40	24.39	20.94	18.97	21.00	23.03	22.52	19.58	21.13	17.81	12.43	13.06
1886	20.60	13.52	16.71	15.90	20.87	23.45	23.03	27.23	24.03	21.20	22.55	18.87	19.81
In 1886 **Greater** than Av. for 12 yrs, 1874-85	.....	.....	.....	.....	.....	.....	.....	2.45	.....	.....	2.21	2.92	5.18
In 1886 **Less** than Av. for 12 years, 1874-85	0.43	3.44	2.73	3.56	1.74	1.37	0.48	.....	1.60	2.98	.....	.....	.....
In 1886 **Greater** than in 1885	1.24	.....	.....	.....	1.90	2.45	0	4.71	4.45	0.07	4.74	6.44	6.75
In 1886 **Less** than in 1885	.....	3.88	7.68	5.04	.....	.....	0	.....	.....	.....	.....	.....	.....

* For the years 1874-6, 1878, 1879 (except Nov. and Dec.), and 1880, the computations were made from the report of observations published in the Reports of the State Board of Agriculture for those years. For 1877, 1881 (except Jan.), 1882-86, the computations were made from registers or copies of registers supplied by Dr. Kedzie.

TABLE III.—*Average Daily Range of Temperature, by Registering Thermometers, during the Year and during each Month of the Year 1886, at each of 18 Stations in Michigan, and Average for the 18 Stations.*

Stations in Michigan.* (Those of the U. S. Signal Service in Italics.)	Divisions of the State.†	Norm. ‡	Average Daily Range of Temperature.—Degrees Fahr.												
			Yr., 1886.	Months, 1886.											
				Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 18 stations §	.....	.....	18.53	13.65	17.40	15.93	20.11	21.87	22.02	22.94	19.77	18.83	19.31	15.11	15.44
Marquette	U. P.	.....	17.73	14.10	19.30	16.40	18.50	21.50	20.10	20.40	18.00	18.30	20.20	12.81	13.15
Manistique and Gulliver Lake A	U. P.	.....	21.79	21.16	25.32	24.77	23.73	23.35	24.47	25.39	21.19	19.13	19.87	16.17	16.90
Escanaba	U. P.	16.57 7	16.59	13.30	17.90	16.40	17.30	17.70	20.40	18.80	15.60	15.10	16.20	14.84	15.50
Traverse City	N. W.	18.53 5	18.21	13.32	20.11	17.87	21.07	22.00	21.23	20.94	17.87	17.93	18.71	14.83	12.65
Mackinaw City	N.	15.72 2	15.87	15.20	18.60	15.60	15.80	19.40 c	18.50 b	19.30	15.40	14.90	15.10	11.90	10.70
Alpena	N. E.	16.36 7	15.98	12.50	17.10	14.30	15.90	18.50	18.30	19.10	16.80	17.20	17.40	13.70	11.00
Harrisville	N. E.	21.57 2	21.61	16.61	20.50	17.35	21.03	26.90	27.43	28.03	24.26	22.13	19.45	16.97	18.71
Grand Haven	W.	13.94 8	14.89	10.50	14.60	12.40	18.50	16.50	16.20	17.00	16.50	13.90	16.10	14.06	12.44
Pentwater	W.	.....	25.02	18.84	23.39	20.52	26.07 d	27.90	30.23	31.39 a	27.45	22.77	29.45	20.80	21.40 a
Reed City	W.	.....	¶	16.50 a	24.89	23.32	28.31	32.52	33.97 e	34 60 b	.....	.....	.....	.....	.....
East Saginaw	B. & E.	 7	21.47	13.98	19.08	17.91 a	25.73	26.42	27.00	25.42	23.05	22.53 b	21.67	17.64	17.18
Port Huron	B. & E.	16.09 7	16.12	11.60	14.50	13.00	17.30	18.70	17.50	17.80	16.70	19.90	17.79	14.33	14.35
Thornville	B. & E.	16.76 5	16.70	10.55	13.96	12.90	19.07	20.06	20.57	22.13	18.32	19.10	16.61	12.07	15.10
Agr'l College	C.	20.01 5	20.60	13.52	16.71	15.90	20.87	23.45	23.03	27.23	24.03	21.20	22.55	18.87	19.81
Ionia	C.	 8	**	16.32	19.18	15.00 c	19.43	.....	.....	26.48	21.58	20.77	19.71	16.10	18.45
Lansing	C.	19.36 3	19.76	14.52	16.79	16.81	20.93	23.23	22.77	23.77	21.16	20.27	21.55	17.33	17.94
Swartz Creek	C.	20.31 5	21.40	14.42	17.71	16.55	21.87	25.10	24.97	28.10 c	24.65 c	21.87	21.71	18.73	21.10 a
Ann Arbor	S. C.	18.14	17.77	12.70	15.30	14.40	19.80	20.30	22.00	24.60	20.40	18.10	17.20	12.90	15.50
Battle Creek	S. C.	.....	§§	24.77	23.10	.....	29.53 c	33.55	31.17	27.67	27.42	.....	21.39	.....	.....
Hudson	S. C.	.....	22.51	14.19	18.25	17.03	24.85	27.06	27.23	31.03	25.26	23.33	24.65	18.03	19.26
Kalamazoo	S. C.	 5	17.05	13.50	15.20	16.15	20.45	21.05	20.57	22.10	16.98	16.77	16.52	12.08	13.27
Marshall	S. C.	19.36	20.27	12.90	15.54	17.23	23.00	25.13	25.93	26.42	22.71	20.33	21.65	15.30 b	17.10
Birmingham	S. E.	 8	||||	16.27	18.41	16.26	20.77	25.10	24.85	.....	.....	.....	20.65	16.66	21.13
Detroit	S. E.	15.81	15.42	13.90	16.40	14.60	15.80	17.90	17.30	17.40	15.30	15.20	14.80	13.60	12.80

* The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit 1, page 30.

† For counties in each division see Exhibit I, in a paper which follows on weekly reports of diseases.

‡ Numbers in this column state the annual average range of temperature for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the range of temperature, denote the number of years included in the average

§ This line is an average for all stations for which statements nearly complete are given for every month of the year. It does not include the lines for Manistique and Gulliver Lake, Reed City, Ionia, Swartz Creek, Battle Creek, and Birmingham.

¶ The average for 7 months in 1886 is 27.73. ** For 10 months, 19.30. §§ For 8 months, 27.33. |||| For 9 months, 20.01.

a, b, c, In the columns from January to December, inclusive, the letters a, b, c, etc., stand directly above the numbers from which they refer to the notes below.

a For 30 days. b For 29 days. c For 27 days. d For 26 days. e For 23 days.

A The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer with the same instruments at Gulliver Lake. Gulliver Lake is about 12 miles east from Manistique.

NOTE.—Graphic representations of statements in Table III, are given in Diagram No. II, page 51.

TABLE IV.—ABSOLUTE HUMIDITY.—*The Average Number of Grains of Vapor of Water in a Cubic Foot of Air for Months and Year 1886, at 16 Stations in Michigan,—Average of Observations made Daily at 7 A. M., 2 P. M., and 9 P. M.,* by Observers† for the State Board of Health, and for the U. S. Signal Service.*

Stations in Michigan.† (Those of U. S. Signal Service in Italics.)	Divisions of the State.‡	Grains of Vapor in a Cubic Foot of Air.—(Absolute Humidity.)‖													
		Year.		Months, 1886.											
		Norm. §	1886.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 16 Stations.¶	.....	.....	3.32	1.32	1.48	1.82	3.11	3.82	4.98	5.59	5.75	4.94	3.64	2.02	1.36
Marquette	U. P.	.....	2.78	1.13	1.23	1.34	2.57	3.03	4.05	4.77	4.94	4.16	3.35	1.75	1.09
Manistique and Gulliver Lake B.	U. P.	.....	3.06	1.33	1.45	1.78	2.59	3.27	4.36	5.41	5.37	4.31	3.51	1.97	1.36
Escanaba	U. P.	2.88 7 5	2.90	1.03	1.16	1.49	2.44	3.23	4.50	5.22	5.20	4.38	3.47	1.63 f	1.04
Traverse City	N. W.	3.37 3	3.46	1.55	1.50	1.85	3.15	3.77	4.97	5.92	6.01	5.04	3.94	2.17	1.63
Mackinaw City	N.	2.87 8	2.93	1.04	1.19	1.43	2.34	3.20	4.39	5.24	5.27	4.39	3.50	1.92	1.27
Alpena	N. E.	2.94 2	3.05	1.16	1.20 i	1.59	2.60	3.39	4.63	5.45	5.42	4.58	3.43	1.93	1.22
Harrisville	N. E.	2.74 8	2.86	0.94	1.08	1.41	2.39	3.16	4.51	5.30	5.35	4.34	3.17	1.65	1.00
Grand Haven	W.	3.45	3.30	1.27	1.54	1.79	3.16 m	3.66	4.80	5.94	5.62	4.80	3.71	2.00	1.34
Muskegon	W.	.....	**	.....	.....	.....	4.35	3.91	5.19	5.67	6.08	5.07	3.96	2.39	.....
Pentwater	W.	.....	3.30	1.36 d	1.59	1.87	3.20 l	3.63	4.59 d	5.52 e	5.83	4.89	3.67	2.03	1.45 e
Reed City	W.	 8	††	0.94	1.25	1.36	3.08	3.45	4.22	4.39	.....	.....	.....	.....	.....
Port Huron	B. & E.	3.34 10	3.32	1.38	1.43 i	1.85	2.95	3.59	4.94	5.68	5.77	5.02	3.87	2.11	1.25
Thornville	B. & E.	3.73 7	3.69	1.59	1.71	2.08	3.59	4.41	5.69	6.02	6.16	5 52	3.78	2.22	1.52
Agr'l College	C.	3.55 8	3.50	1.42	1.66	1.94	3.41	4.57	5.42	5.45	5.84	5.18	3.62	2.05	1.39
Lansing, S. B. of H.‡‡	C.	3.39 3	3.37	1.38	1.54	1.88 a	3.27	4.03	5.26	5.47	5.69	5.02	3.57	1.97	1.40
Swartz Creek	C.	3.30 6	3.33	1.33	1.51 i	1.92	3.29	4.02	5.25	5.27 d	5.62 h	5.09	3.54	1.91	1.25 d
Ann Arbor A	S. C.	3.40	3.46	1.44 f	1.60 k	2.08	3.41 d	4.26	5.27	5.39 j	6.00	5.20	3.65 a	2.16 g	1.06 f
Battle Creek	S. C.	.....	‖‖	1.40	1.67	.....	3.56	4.56	5.46	6.22	6.66	.....	4.53	2.57	1.69
Kalamazoo	S. C.	 5	3.47	1.38	1.54	1.95 a	3.51	4.16	5.17	5.57	5.93	5.17	3.60	2.11	1.49
Marshall	S. C.	3.69	3.90	1.56 b	1.87 j	2.44	4.15 f	4.62 a	5.66 d	6.20	6.63	5.91	4.00 f	2.33 g	1.45 c
Birmingham	S. E.	 10	¶¶	1.44	1.58	2.09	3.81	4.78	6.21	.....	.....	.....	3.89	2.09	1.27
Detroit	S. E.	3.56	3.75	1.54	1.77	2.18	3.54	4.44	5.79	6.29	6.27	5.48	3.97	2.35	1.36

* At the U. S. Signal Service stations for the year 1886, the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th Meridian time. The local time corresponding to these hours is stated in the star (*) footnote to Table I., page 47.

† The names of observers, their places of observation, and the counties in which these places are situated are stated in Exhibit 1, page 30.

‡ The full names of the divisions and the counties in each division are stated in Exhibit I, in a paper which follows, on weekly reports of sickness.

§ Numbers in this column state the average annual Absolute Humidity for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the Absolute Humidity, denote the number of years included in the average.

‖ The number of grains of vapor in a cubic foot of air at each observation was determined from readings of the psychrometer by means of Glaisher's table, Table XII. of the Smithsonian Meteorological and Physical Tables (1859).

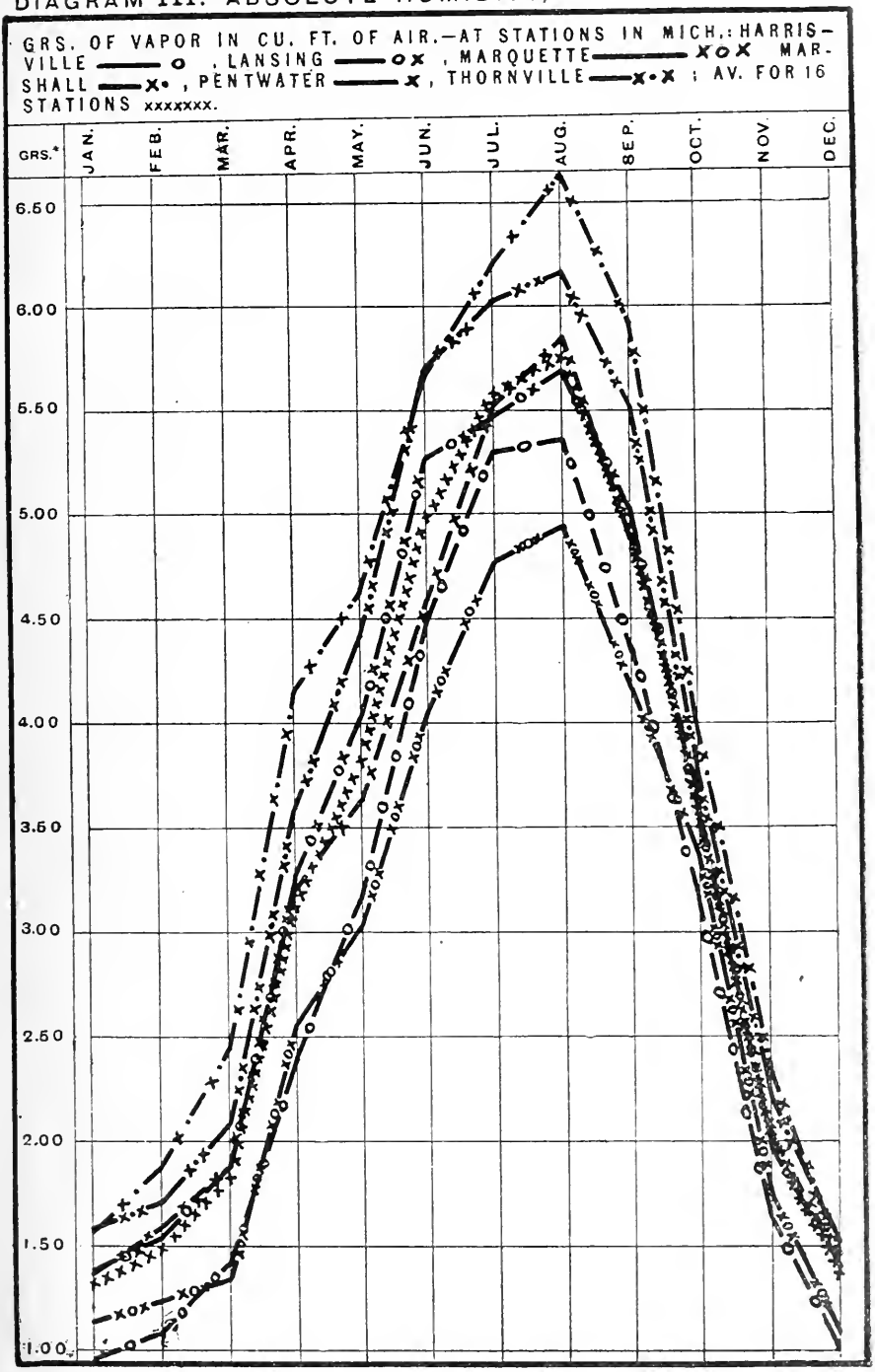
¶ This line is an average for only the stations from which statements, nearly complete, were received for every month in the year. It does not include the lines for Manistique and Gulliver Lake, Muskegon, Reed City, Swartz Creek, Battle Creek and Birmingham.

** The average for 8 months in 1886 is 4.58. †† For 7 months, 2.67. ‖‖ For 10 months, 3.83. ¶¶ For 9 months, 3.02.

A The computations of Absolute Humidity at Ann Arbor for each month in 1886 were furnished by the observer there. All other computations in Table IV. were made at the office of the Secretary of the State Board of Health.

‡‡, a, b, c, B, foot-notes on page 56.

DIAGRAM III.—ABSOLUTE HUMIDITY, BY MOS., IN 1886.



*SCALE, ONE GRAIN OF VAPOR (IN A CU. FT. OF AIR) TO 1.12 IN. VERTICALLY

H. B. T., DEL. DES. BY H. B. S.

EXHIBIT 11.—*Average Absolute Humidity, by Year and Months, in 1886, compared with Annual and Monthly Averages for 1885, and for the 10 Years 1877-86.* These Averages are for Groups of several Stations in Michigan.†*

Years, Etc.	Absolute Humidity—Grains of Vapor in a Cubic Foot of Air.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 Yrs., 1877-86†..	3.44	1.38	1.51	1.81	2.75	3.91	5.27	6.07	5.84	4.98	3.71	2.30	1.73
1885 (18 stations†)....	3.14	1.14	0.94	1.25	2.53	3.62	4.90	6.12	5.29	4.56	3.17	2.50	1.72
1886 (16 stations†)....	3.32	1.32	1.48	1.82	3.11	3.82	4.98	5.59	5.75	4.94	3.64	2.02	1.36
In 1886 **Greater** than Av. for 10 yrs., 1877-86.....	.....	.....	.....	0.01	0.36	.....	.....	.....	.....	.....	.....	.....	.....
In 1886 **Less** than Av. for 10 yrs. 1877-86.....	0.12	0.06	0.03	.....	.....	0.09	0.29	0.48	0.09	0.04	0.07	0.28	0.37
In 1886 **Greater** than in 1885.....	0.18	0.18	0.54	0.57	0.58	0.20	0.08	.....	0.46	0.38	0.47	.....	.....
In 1886 **Less** than in 1885.....	.....	.....	.....	.....	.....	.....	.....	0.53	.....	.....	.....	0.48	0.36

* Beginning with the year 1885, allowance must be made for Lansing in Exhibit 11, because of a change in the location of the instruments. The amount of variation by months is shown in Exhibit C., on page 23, Report for 1886.

† Thornville and Detroit for 1877-86; Kalamazoo for 1877-83 and 1886; Mendon for 1877-82; Tecumseh for 1878-85; Battle Creek for 1877-79, 1882 and 1885; Otisville for 1878-80, and 1882; Marquette for 1879-84, and 1886; Alpena, Grand Haven, Port Huron, Lansing for 1879-86; Agricultural College for 1877-8 and 1881-6; Niles for 1878-9 and 1881; Nirvana for 1878-9 and first 4 months of 1880; Reed City for last 8 months of 1880 and 1881-5; Benton Harbor and Coldwater for 1877-8; Escanaba for 1880-86; Washington for 1880-83; Petoskey for 1879; Winfield for 1881 and 1883; Ann Arbor for 1881-6; Woodmere Cemetery (near Detroit) for 1877-9; Traverse City and Marshall for 1882-6; Harrisville for 1882 and 1885-6; Hastings and Parkville for 1882; Hillsdale for 1882-4; Manistique and Swartz Creek for 1884-5; Mackinaw City for 1884-6; Ionia for 1884; Pentwater for 1886.

Exhibit 12 states the annual and monthly average at the State Agricultural College for twenty years, and gives comparisons of 1886 with this average, and with the year 1885. Exhibit 11 states the average of all stations in Michigan, for a period of ten years, and compares 1886 with this average, and with the year 1885. The absolute humidity at each of eighteen stations by months in 1886, is stated in Table IV., page 54.

Foot-notes from page 54.

‡‡ Beginning with the year 1885, allowance must be made for Lansing in Table IV., because of a change in the location of the instruments. The amount of the variation by months is shown in Exhibit C, page 23, Report for 1886.

a, b, c. In the columns from January to December, inclusive, the letters a, b, c, stand directly above the numbers from which they refer to the notes below.

a For 92 observations. b For 91 observations. c For 90 observations. d For 89 observations.
e For 88 observations. f For 87 observations. g For 86 observations. h For 85 observations.
i For 83 observations. j For 80 observations. k For 76 observations. l For 73 observations.
m For 57 observations.

B The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer with the same instruments at Gulliver Lake. Gulliver Lake is about 12 miles east from Manistique.

The lines for 6 stations in Table IV. are graphically represented in Diagram III., page 55.

EXHIBIT 12.—*Comparison of the Average Absolute Humidity for the Year, and for each Month of the Year 1886, with averages for the 20 Years 1866-85, and for the Year 1885. Observations made at 7 A. M., 2 P. M., and 9 P. M., daily, by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Mich.*

Years, Etc.	Absolute Humidity—Grains of Vapor in a Cubic Foot of Air.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 20 Yrs., 1866-85..	3.48	1.44	1.53	1.85	2.65	4.02	5.63	6.51	6.01	4.86	3.37	2.19	1.66
1885.....	3.32	1.28	1.03	1.46	2.77	3.90	5.33	6.43	5.48	4.62	3.17	2.47	1.90
1886.....	3.50	1.42	1.66	1.94	3.41	4.57	5.42	5.45	5.84	5.18	3.62	2.05	1.39
In 1886 **Greater** than av. for 20 yrs., 1866-85.....	0.02	.....	0.13	0.09	0.76	0.55	.....	.....	.....	0.32	0.25	.....	.....
In 1886 **Less** than av. for 20 yrs. 1866-85.....	.....	0.02	.....	.....	.....	.....	0.21	1.06	0.17	.....	.....	0.14	0.27
In 1886 **Greater** than in 1885.....	0.18	0.14	0.63	0.48	0.64	0.67	0.09	.....	0.36	0.56	0.45	.....	.....
In 1886 **Less** than in 1885.....	.....	.....	.....	.....	.....	.....	.....	0.98	.....	.....	.....	0.42	0.51

EXHIBIT 13.—*Average Relative Humidity, by Year and Months, in 1886,* compared with Annual and Monthly Averages for 1885, and for the Nine Years, 1878-86. These Averages are for Groups of several Stations in Michigan.†*

Years, Etc.	Per Cent of Saturation.—Relative Humidity.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 9 yrs, 1878-86†...	75	81	80	77	69	68	72	72	74	75	76	79	82
1885 (18 stations†)....	76	80	80	77	72	69	70	71	78	75	79	82	82
1886 (16 stations†)....	77	85	82	80	76	72	72	71	75	78	75	76	82
In 1886 **Greater** than Av. for 9 yrs., 1878-86.....	2	4	2	3	7	4	0	.....	1	3	.....	.....	0
In 1886 **Less** than Av. for 9 yrs., 1878-86	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	3	.....
In 1886 **Greater** than in 1885.....	1	5	2	3	4	3	2	0	.....	3	.....	.....	0
In 1886 **Less** than in 1885.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	4	6	.....

* Beginning with the year 1885, allowance must be made for Lansing in Exhibit 13, because of a change in the location of the instruments. The amount of the variation is shown in Exhibit D, on page 23, Report for 1886.

† Thornville and Detroit for 1878-86; Kalamazoo for 1878-83 and 1886; Mendon for 1878-82; Tecumseh for 1878-85; Otisville for 1878-80 and 1882; Nirvana and Woodmere Cemetery (near Detroit) for 1878-79; Nirvana and Reed City for 1880; Ann Arbor for 1881-6; Niles for 1878-9 and 1881; Marquette for 1879-84 and 1886; Alpena, Grand Haven, Port Huron and Lansing for 1879-86; Agricul;tural College for 1878 and 1881-6; Escanaba for 1880-6; Washington for 1880-3; Coldwater for 1878 Petoskey for 1879; Mallory Lake and Hudson for 1881; Marshall, Traverse City for 1882-6; Hillsdale for 1882-4; Hastings for 1882; Harrisville for 1882 and 1885-6; Winfield for 1883; Reed City for 1881-5; Battle Creek for 1878-9, 1882, 1885; Manistique and Swartz Creek for 1884-5; Mackinaw City for 1884-6; Ionia for 1884; Pentwater for 1886.

Foot-notes from page 58.]

¶¶ The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer with the same instruments at Gulliver Lake. Gulliver Lake is about 12 miles east from Manistique.

Graphic representations of 6 representative lines in Table V. are given in Diagram IV., page 59.

TABLE V.—RELATIVE HUMIDITY.—*Average Per Cent of Saturation of the Atmosphere with Vapor of Water during the Year, and during each Month of the Year 1886, at 16 Stations in Michigan.—Aervage of Observations made Daily at 7 A. M., 2 P. M., and 9 P. M.,* by Observers† for the State Board of Health, and for the U. S. Signal Service.*

Stations in Michigan.† (Those of the U. S. Signal Service in Italics.)	Divisions of the State.†	Per Cent of Saturation.—Relative Humidity.												
		Year.		Months, 1886.										
		Norm. ‡	1886.	Jan.	Feb.	Mar.	Apr.	May	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 16 Stations.§	.....	.....	77	85	82	80	76	72	72	71	75	78	75	76	82
Marquette	U. P.	.....	77	89	85	76	77	66	73	69	75	77	73	79	79
Manistique and Gulliver Lake¶¶	U. P.	 7	81	91	90	83	79	71	74	72	76	80	82	85	93
Escanaba	U. P.	74 5	77	80	79	79	80	69	71	71	79	83	82	73 f	77
Traverse City	N. W.	84 3	84	96	90	88	85	77	76	77	79	82	80	85	96
Mackinaw City	N.	75 8	73	73	70	72	76	70	75	73	77	75	75	71	74
Alpena	N. E.	76	82	83	80 i	84	85	77	80	79	82	85	81	82	83
Harrisville	N. E.	 8	65	61	60	68	67	60	66	66	69	68	63	62	64
Grand Haven	W.	76	77	81	80	78	74 m	75	75	83	76	74	77	73	79
Muskegon	W.	.....	¶	.....	.....	.....	73	71	70	68	75	74	79	86	.....
Pentwater	W.	.....	77	86 d	88	83	75 l	73	72 d	73 e	75	75	74	73	82 e
Reed City	W.	 8	‖	64	71	64	70	57	52	53	.....	.....	.....	.....	.....
Port Huron	B. & E.	77 9	78	85	81 i	81	77	76	76	75	78	78	80	76	77
Thornville	B. & E.	79 23	79	95	91	83	74	73	73	71	74	75	72	79	93
Agr'l College	C.	79 8	78	91	86	80	73	79	73	65	71	80	73	78	87
Lansing, S. B. of H.§§	C.	72 2	75	89	83	77 a	68	68	70	64	72	76	73	75	87
Swartz Creek	C.	76 6	75	86	83 i	69	73	69	70	64 d	71 h	77	75	75	83 d
Ann Arbor	S. C.	78	76	90 f	84 k	82	75 d	71	68	59 j	72	76	75 a	80 g	84 f
Battle Creek	S. C.	.....	††	78	76	.....	60	64	62	64	76	.....	83	84	85
Kalamazoo	S. C.	 5	74	86	81	75 a	68	66	65	62	70	75	73	79	92
Marshall	S. C.	77	80	92 b	89 j	89	81 f	70 a	68 d	66	77	85	75 f	81 g	84 c
Birmingham	S. E.	 9	‡‡	89	87	87	83	84	86	.....	.....	.....	83	79	83
Detroit	S. E.	72	76	80	78	77	74	75	76	75	75	76	73	74	76

NOTE.—The tri-daily observations with the psychrometer at Marquette, Escanaba, Mackinaw City, Grand Haven, Port Huron and Detroit for 1886 were reduced (by Tables in "Signal Service Order No. 41, 1881, and in Instructions to Voluntary Observers," 1882), and the monthly means for those months were computed, by the observers at those stations. In all other cases the observations were reduced by Guyot's table, in Smithsonian Meteorological Tables, or by a table substantially the same as that. Computations for Ann Arbor for each month in 1886 were made by the observers there. All other computations in Table V. were made at the office of the State Board of Health.

* At the stations of the U. S. Signal Service for the year 1886, the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th Meridian time. The corresponding local time for each of these stations is stated in the star (*) foot-note to Table I., page 47.

† The names of observers, their places of observation, and the counties in which these places are situated are stated in Exhibit I, page 30. The full names of the divisions and the counties in each division are stated in Exhibit I, in a paper which follows, on weekly reports of diseases.

‡ Numbers in this column state the average annual Relative Humidity for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of the numbers which state the Relative Humidity, denote the number of years, including the average.

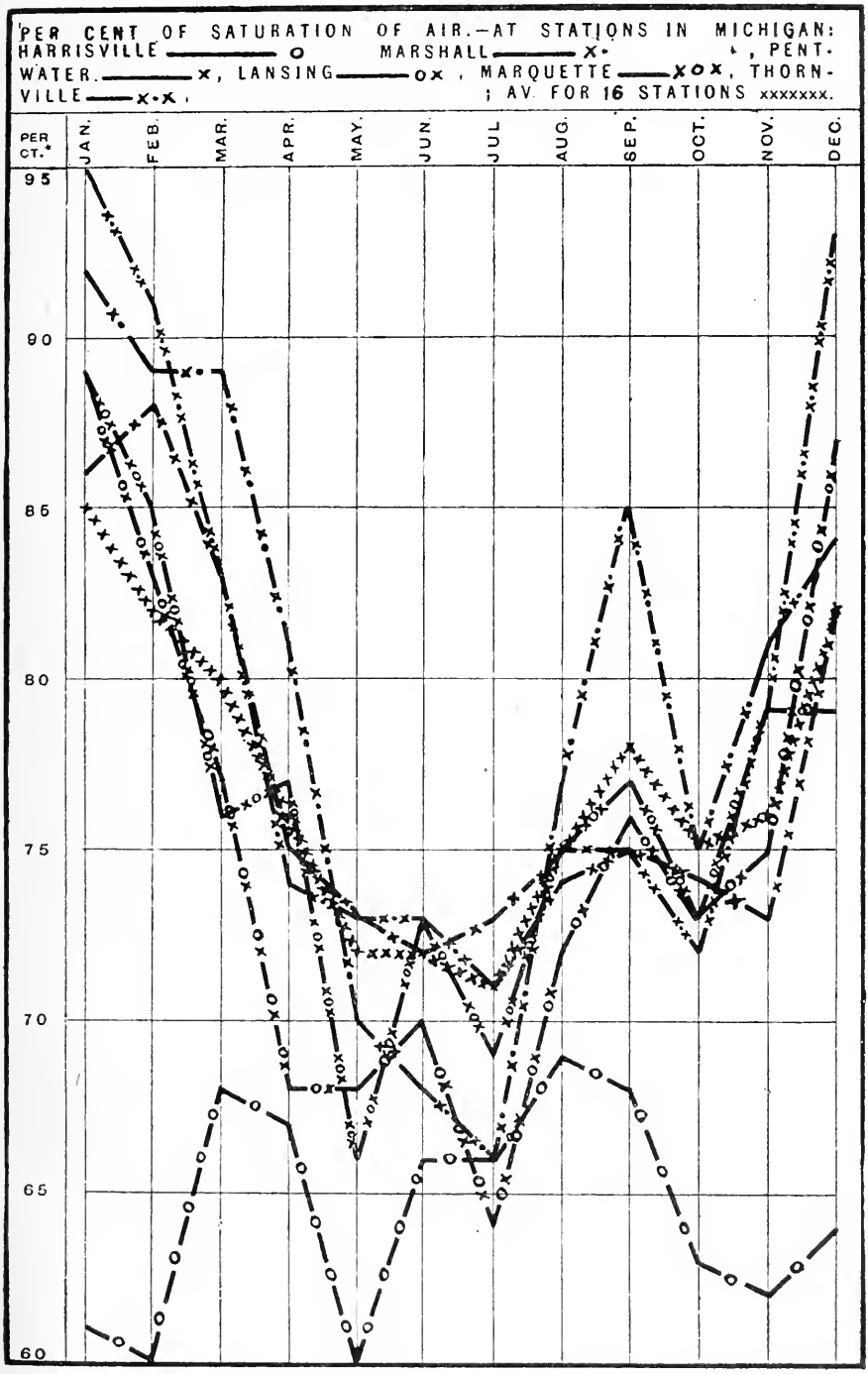
§ This line is an average for only the stations from which statements, nearly complete, were received for every month in the year. It does not include Manistique and Gulliver Lake, Muskegon, Reed City, Swartz Creek, Battle Creek and Birmingham.

¶ The average for 8 months in 1886 is 75. ‖ For 7 months, 62. †† For 10 months, 73. ‡‡ For 9 months 85.

§§ Beginning with the year 1885, allowance must be made for Lansing in Table V. because of a change in location of the instruments. The amount of the variation by months is shown in Exhibit D, page 23, Report for 1886. a, b, c. In the columns from January to December, inclusive, the letters a, b, c, etc., stand directly above the numbers from which they refer to the notes below.

a For 92 observations. b For 91 observations. c For 90 observations. d For 89 observations.
e For 88 observations. f For 87 observations. g For 86 observations. h For 85 observations.
i For 83 observations. j For 80 observations. k For 76 observations. l For 73 observations.
m For 57 observations.

DIAGRAM IV.—RELATIVE HUMIDITY, BY MOS., IN 1886.



*SCALE. TEN PER CENT OF SATURATION TO 1.82 IN., VERTICALLY.

H. B. T., DEL. DES. BY H. B. B.

EXHIBIT 14.—*Comparison of the Average Relative Humidity of the Air (Per Cent of Saturation) for the Year and for each Month of the Year 1886, with Averages for the 22 Years, 1864–85, and for 1885. Observations made at 7 A. M., 2 P. M. and 9 P. M. Daily, by Prof. R. C. Kedzie, at the State Agricultural College near Lansing, Michigan.*

Years, etc.	Per Cent of Saturation.—Relative Humidity.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 22 yrs. 1864–85	79	86	86	84	71	69	76	74	77	80	80	82	87
1885	81	90	91	88	73	67	75	71	80	78	83	84	90
1886	78	91	86	80	73	79	73	65	71	80	73	78	87
In 1886 **Greater** than av. for 22 yrs., 1864–85	------	5	0	------	2	10	------	------	------	0	------	------	0
In 1886 **Less** than av. for 22 yrs., 1864–85	1	------	0	4	------	------	3	9	6	0	7	4	0
In 1886 **Greater** than in 1885	------	1	------	------	0	12	------	------	------	2	------	------	------
In 1886 **Less** than in 1885	3	------	5	8	0	------	2	6	9	------	10	6	3

FOGS.

For the year 1886, fog was reported at 282 morning observations, at 94 afternoon observations (at about 2 P. M.), at 168 evening observations (at about 9 P. M.), and 53 times during the day, no special time being mentioned, in many cases the same fog, or fog at the same time, being reported by different observers. Fog was reported at one or more stations at some time during the day, on 174 days.

EXHIBIT 15.—*Number of DifferentDays on which Fog was Observed at one or more of 19 Stations* in Michigan in 1886, and in each Month of the Year 1886.*

Year 1886.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
174	11	14	8	16	17	16	18	22	19	16	7	10

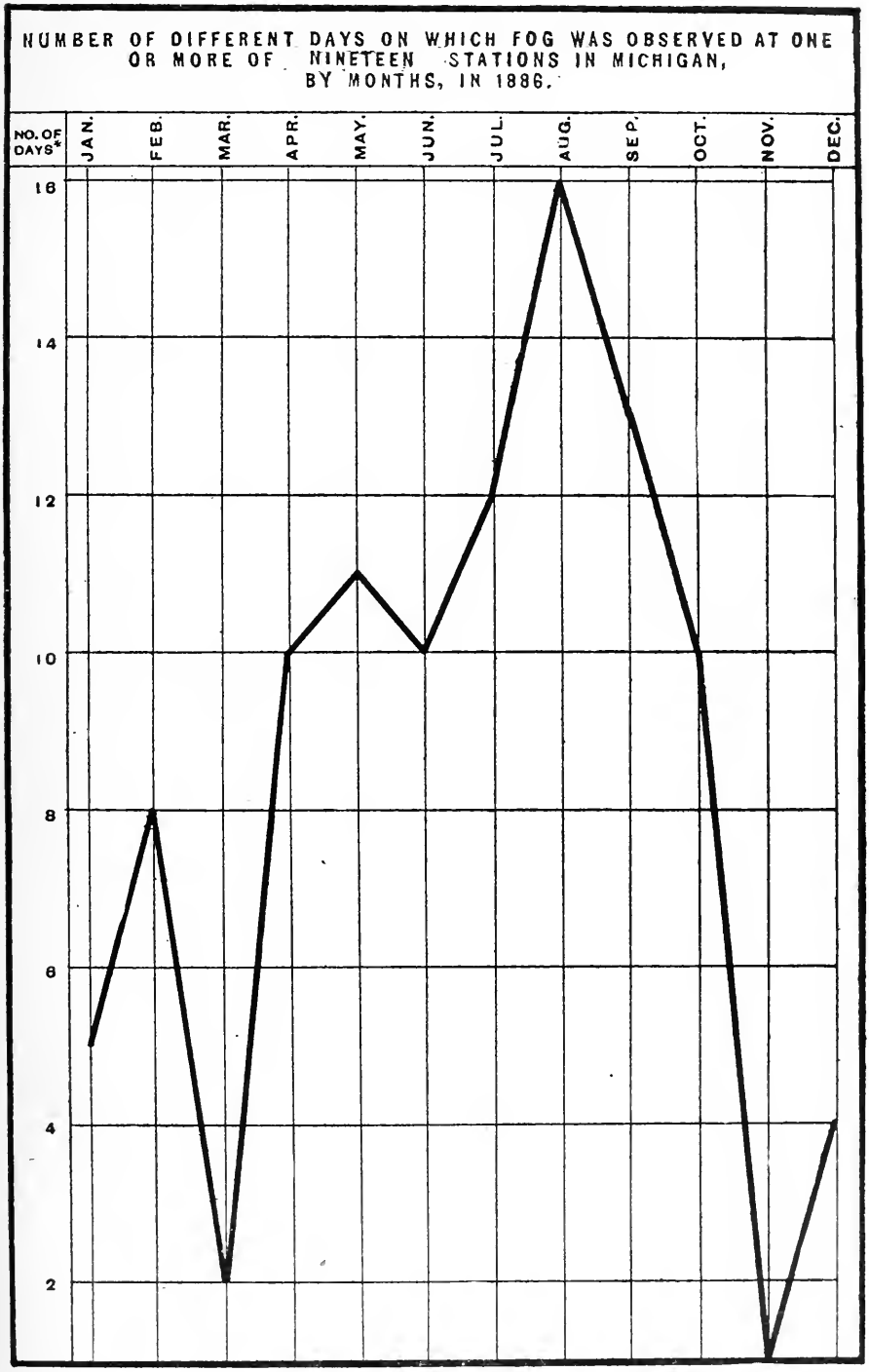
NOTE.—Graphic representations of Statements in Exhibit 15 are given in Diagram No. V., page 41.
* This exhibit contains statements only for those localities from which reports were received for every month of the year, as follows: Marquette, Escanaba, Traverse City, Mackinaw City, Alpena, Harrisville, Grand Haven, Pentwater, East Saginaw, Port Huron, Thornville, Agricultural College, Lansing, Ann Arbor, Kalamazoo, Marshall, Parkville, Hudson and Detroit.

EXHIBIT 16.—*Number of Observations at which Fog was Observed in Michigan in 1886, and in each month of the Year 1886. Observations taken three times Daily at 19 Stations.**

Year 1886.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
597	40	50	34	64	43	44	40	74	58	76	16	58

* This Exhibit contains statements only for those localities from which registers were received for every month of the year, as stated in a foot-note to Exhibit 15, above.

DIAGRAM V.–CONCERNING FOGS IN MICHIGAN, IN 1886.



*SCALE, ONE DAY TO .42 IN VERTICALLY.

H. B. T. DEL. DES. BY H. B. B.

EXHIBIT 17.—*Number of different Days on which Fog was recorded in 1886, and in each*

Stations in Michigan.*	No. of days in 1886.	January.			February.			Line Number.
		Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.		
			A. M.	P. M.		A. M.	P. M.	
	30	0	.....	.....	11	6:11	.....	1
Marquette	.....	.....	.....	.....	12	.....	2:11	2
	.....	.....	.....	.....	.....	.....	.....	3
	.....	.....	.....	.....	.....	.....	.....	4
	13	0	.....	.....	11, 12	.....	2	5
	.....	.....	.....	.....	.....	.....	.....	6
Manistique	.....	.....	.....	.....	.....	.....	.....	7
	.....	.....	.....	.....	.....	.....	.....	8
	.....	.....	.....	.....	.....	.....	.....	9
	.....	.....	.....	.....	.....	.....	.....	10
Gulliver Lake	9	.....	.....	.....	.....	.....	.....	11
	.....	.....	.....	.....	.....	.....	.....	12
	59	1	.....	10:12	5	6:12	.....	13
	.....	2	6:12	2:12	8, 12, 20	.....	10:12	14
Escanaba	.....	15	.....	2:12 & 10:12	11	6:12	2:12& 10:12	15
	.....	16	6:12	2:12 & 10:12	19	.....	2:12	16
	.....	17	.....	.....	9,13,18,21,22	.....	.....	17
	.....	20	.....	2:12	.....	.....	.....	18
Traverse City	8	0	.....	.....	0	.....	.....	19
	.....	.....	.....	.....	.....	.....	.....	20
	45	3, 4	.....	2:22	11, 24	.....	10:22	21
Mackinaw City	.....	.....	.....	.....	12	6:22	2:22& 10:22	22
	.....	.....	.....	.....	13, 25	6:22	.....	23
	.....	.....	.....	.....	.....	.....	.....	24
	.....	.....	.....	.....	.....	.....	.....	25
	31	3	6:26	2:26 & 10:26	9	6:26	.....	26
Alpena	.....	4	early	till 1:45	12	.....	2:26& 10:26	27
	.....	.....	.....	.....	.....	.....	.....	28
	.....	.....	.....	.....	.....	.....	.....	29
	.....	.....	.....	.....	.....	.....	.....	30
Harrisville	11	2, 3, 4	.....	.....	12	.....	.....	31
	71	3	6:15	2:15 & 10:15	12	.....	2:15& 10:15	32
Grand Haven	.....	.....	.....	.....	.....	.....	.....	33
	.....	.....	.....	.....	.....	.....	.....	34
	.....	.....	.....	.....	.....	.....	.....	35
	.....	.....	.....	.....	.....	.....	.....	36
Pentwater	1	0	.....	.....	0	.....	.....	37
Reed City	2	0	.....	.....	12	.....	9	38
	.....	.....	.....	.....	13	7	.....	39
East Saginaw	6	0	.....	.....	12	A. M.	P. M.	40
Port Austin	5	0	.....	.....	0	.....	.....	41
	.....	.....	.....	.....	.....	.....	.....	42
	55	25	.....	2:30	12	.....	2:30& 10:30	43
Port Huron	.....	.....	.....	.....	13, 14	6:30	.....	44
	.....	.....	.....	.....	.....	.....	.....	45
	.....	.....	.....	.....	.....	.....	.....	46
	.....	.....	.....	.....	.....	.....	.....	47
Thornville	16	3, 26, 28	A. M.	P. M.	13	A. M.	P. M.	48
Agr'l College	6	0	.....	.....	0	.....	.....	49
Lansing, S. B. of H.	22	3	7	till 5	12	8 till	night	50
	.....	25	9 till 10	.....	.....	.....	.....	51
Swartz Creek	7	3	10	.....	12	.....	3 till 10	52
Ann Arbor	15	3	7	2 & 9	12	.....	9	53
	.....	.....	.....	.....	14	7	.....	54
Hudson	5	0	.....	.....	12	.....	.....	55
Parkville	29	3	.....	.....	12, 13	.....	.....	56
Birmingham	15	3	7	2	12	7	2	57
	.....	.....	.....	.....	13	7	.....	58
	37	0	.....	.....	12	.....	2:28& 10:28	59
Detroit	.....	.....	.....	.....	13	6:28	.....	60
	.....	.....	.....	.....	.....	.....	.....	61

* The names of observers, their places of observation, and the counties in which the places are situated, are stated in Exhibit 1, page 30.

Month the Dates and Hours of Observation when Fogs were recorded at 27 Stations in Michigan.

Line Number.	March.			April.			May.			June.		
	Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.	
		A. M.	P. M.		A. M.	P. M.		A. M.	P. M.		A. M.	P. M.
1	17	.....	2:11	26	6:11	.....	10, 18	.....	2:11	1, 15	.....	2:11 & 10:11
2	18	6:11	2:11	.....	.....	.....	30	6:11	.....	22	.....	10:11
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	23	6:11	.....
4	.....	.....	.....	.....	.....	.....	.....	.....	.....	24	.....	2:11
5	0	.....	.....	12	.....	4 till 9:15	4	6 till 8	.....	.....	.....	.....
6	.....	.....	.....	13, 26	7	.....	5	4 till 6	.....	.....	.....	.....
7	.....	.....	.....	16	.....	5:30 till 7	11	7:30 till	2:30	.....	.....	.....
8	.....	.....	.....	17	4 till	4	18	.....	4 till	.....	.....	.....
9	.....	.....	.....	8	4 till 8	9	19	11	.....	.....	.....	.....
10	.....	.....	.....	22	.....	1 till 6:30	.....	.....	.....	.....	.....	.....
11	.....	.....	.....	23	5till 8:30	.....	.....	.....	.....	.....	.....	.....
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	13	.....	9
13	17,19,31	.....	10:12	13, 14	6:12	10:12	4, 11, 19	6:12	.....	1	6:12	2:12 & 10:12
14	18	.....	.....	16	6:12	.....	10	.....	10:12	2	.....	.....
15	.....	.....	.....	17, 18	6:12	10:12	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	19	6:12	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	15	.....	9	12	.....	9	18	.....	9	15	.....	9
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	7	.....
21	15, 31	.....	10:22	12	.....	2:22 & 10:22	4, 19	6:22	.....	.....	.....	.....
22	18	6:22	.....	13,17,19	6:22	.....	18	.....	10:22	5, 14, 23, 25,	6:22	.....
23	19	.....	2:22	14	6:22	10:22	.....	.....	.....	13, 15	.....	10:22
24	.....	.....	.....	16, 18	.....	10:22	.....	.....	.....	22	6:22	10:22
25	.....	.....	.....	23	.....	2:22	.....	.....	.....	.....	.....	.....
26	31	.....	4:40 till 8	12	.....	2:26,10:26	11, 18	.....	10:26	15	6:22	10:22
27	.....	.....	.....	13	6:26	10:26	.....	.....	.....	22	6:22	4:15 till 5:30
28	.....	.....	.....	14	6:26	.....	.....	.....	.....	.....	.....	.....
29	.....	.....	.....	18	.....	10:26	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	26	.....	2:26	.....	.....	.....	.....	.....	.....
31	20,30,31	.....	.....	13,14,19	.....	.....	0	.....	.....	0	.....	.....
32	19	.....	10:15	12	6:15	2:15	1, 29	.....	10:15	2, 16, 25, 29	6:15	.....
33	20	.....	2:15	13, 18, 22, 25	6:15	.....	2, 3, 8, 11, 14, 27	6:15	.....	13	.....	2:15,10:15
34	29	6:15	2:15	20, 21	.....	10:15	13, 26	.....	2:15	14	6:15	10:15
35	.....	.....	.....	24	6:15	2:15,10:15	18	.....	2:15,10:15	18	.....	10:15
36	.....	.....	.....	.....	.....	.....	19	6:15	2:15	.....	.....	.....
37	0	.....	.....	12	11	.....	0	.....	.....	0	.....	.....
38	0	.....	.....	0	.....	.....	19	7	.....	0	.....	.....
39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	0	.....	.....	12, 14	.....	.....	0	.....	.....	0	.....	.....
41	0	.....	.....	13	7	2	0	.....	.....	0	.....	.....
42	.....	.....	.....	14, 19	7	.....	.....	.....	.....	.....	.....	.....
43	17,30,31	6:30	.....	12	.....	10:30	10	(8 of 10th till)	12 of 11th	16	.....	2:30
44	29, 30	.....	10:30	13	6:30	2:30,10:30	11	6:30	10:30	29	6:30	.....
45	.....	.....	.....	14, 19	6:30	.....	12	6:30 till 8	.....	.....	.....	.....
46	.....	.....	.....	23	.....	10:30	27	10:25 till	12:30	.....	.....	.....
47	.....	.....	.....	24	6:30	2:30	31	.....	10:30	.....	.....	.....
48	0	.....	.....	0	.....	.....	0	.....	.....	0	.....	.....
49	0	.....	.....	13	7	.....	0	.....	.....	0	.....	.....
50	15	early till 11	.....	13	early till 10	.....	11	7:20 till 9	.....	6	early till 7:30	.....
51	20	10:15 till	1:45	.....	.....	.....	.....	.....	.....	13	.....	† 9
52	0	.....	.....	0	.....	.....	0	.....	.....	14, 22	3 to 6	.....
53	15, 17	7	.....	0	.....	.....	12	morning	.....	10	.....	9
54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
55	17	morning	.....	0	.....	.....	0	.....	.....	0	.....	.....
56	0	.....	.....	13	.....	.....	2, 8, 19	.....	.....	11, 16, 22, 24	.....	.....
57	15, 17	7	.....	14	7	.....	12, 14	7	.....	22	7	.....
58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
59	17, 31	6:28	.....	8, 13, 14, 21	6:28	.....	11	6:28	.....	14	6:28	.....
60	20	.....	2:28	.....	.....	.....	26, 30	.....	10:28	25	.....	10:28
61	30	.....	10:28	.....	.....	.....	.....	.....	.....	.....	.....	.....

NOTE.—Registers were received, but with no fog recorded thereon, from Otsego and Muskegon for each month in 1886. A cipher (0) indicates that a monthly register was received from the station with no fog recorded thereon.

† Lifted in night.

EXHIBIT 17.——CONTINUED.—*Dates when*

Stations in Michigan.*	July.			August.			September.			Line Number.
	Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.		
		A. M.	P. M.		A. M.	P. M.		A. M.	P. M.	
	13		2:11&10:11	13	6:11		23	early till 9		1
	19	6:11		16, 22		2:11	26		lifted 10:40	2
Marquette	26	6:11	2:11	28		2:11 10:11	27		2:11	3
				29	6:11	2:11 10:11				4
	10	7		8	7	2	0			5
Gulliver L'ke				16		2				6
				28, 29	7	2 & 9	5	early till 7:30		7
	1,2,9,19	6:12		18,22,26,29	6:12		5, 23	6:12		8
	13			21		10:12	9, 22, 27		10:12	9
Escanaba				28	6:12	2:12 10:12				10
Traverse City	0			30	7		23	7		11
	26	early till 9:30		7, 23, 30	6:22		16, 24		2:22	12
Macki'w City				22	6:22	2:22	23	6:22	10:22	13
				28, 29	6:22	2:22 10:22				14
	3	9:40	till 11:55	8, 9, 29, 30	6:26		23	6:26		15
	10	early till 9:30		28	6:26	2:26 10:26	24	9:30 till	1:30	16
Alpena	27	early till 8								17
	12		Night.							18
Harrisville	0			0			0			19
	13,18,19, 26,30,31		10:15	3, 28	6:15		2, 20, 22		10:15	20
Gd. Haven	15,27	6:15		6, 7, 31		10:15	23	6:15		21
				25, 26	6:15	10:15	26	6:15	10:15	22
										23
Bay Port				0			0			24
East Saginaw	0			0			0			25
										26
Port Austin	27	A. M.		0			0			27
	2,21,24,27	6:30		6,7,20,23 25,26,27, 28,29,31,	6:30		2,6,7, 8, 23,	6:30		28
Port Huron	20	6:30	10:30	26, 28		10:30	2, 23		10:30	29
							3, 24			30
Thornville	27	Morning		5	Morning		6	Morning		31
							23	8 till 10		32
Ag'l College	0			6, 14	7		0			33
										34
	21	early till 8		5		night till	23	early till 8		35
Lansing, S. B. of H	23	early till 7		6	9					36
				14	early till 8					37
										38
										39
Swartz Creek										40
										41
	0			0			7	7		42
Ann Arbor							24	Morning		43
Battle Creek										44
Hudson	0			0			0			45
Kalamazoo	0			25	7		0			46
										47
Marshall	0			25	7		0			48
Parkville	2,3,13,19,21			25, 28, 30			6, 7, 14			49
Birmingham	0									50
										51
	0			6, 26, 31		10:28	2,3,7,20	6:28	10:28	52
				24, 26, 27	6:28		23	6:28	2:28,10:28	53
							4, 5, 21		10:28	54
Detroit							6,8,13, 18, 24, 27	6:28		55

* The names of observers, their places of observation, and the counties in which these places are situated are stated in Exhibit 1, page 30.

Fogs were Recorded in 1886.

Line Number.	October.			November.			December.		
	Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.		Day of Month.	Hour of Observation.	
		A. M.	P. M.		A. M.	A. M.		A. M.	P. M.
1	11	11:30 till	4:00	10	6:11	.....	10	.....	7:30 till 11:40
2	12	night of 11th till 9 of 12th	.....	.....	.....	.....	.....	.....	.....
3	13	night of 12th till 9:30	.....	.....	.....	.....	.....	.....	.....
4	14	night of 13th till 10:30	.....	.....	.....	.....	.....	.....	.....
5	0	.....	.....	0	.....	.....	10	.....	10 till
6	.....	.....	.....	.....	.....	.....	11	6	.....
7	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	6, 7, 14	6:12	.....	5, 9	.....	10:12	10	.....	2:12
9	13	6:12	2:12	10	6:12	.....	11	6:12	10:12
10	.....	.....	.....	.....	.....	.....	12	6:12	2:12
11	0	.....	.....	0	.....	.....	9	7	.....
12	13	6:22	2:22	23	6:22	.....	11	6:22	2:22 & 10:22
13	19, 29	6:22	.....	.....	.....	.....	12	.....	10:22
14	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	7	6:26	.....	23	6:26	.....	11	.....	10:26
16	9, 10	8:45 of 9th till	night of 10th	.....	.....	.....	12	6:26	2:26 & 10:26
17	13	6:26	2:26	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	0	.....	.....	0	.....	.....	11	.....	.....
20	4,5,6,9,30	6:15	10:15	22	.....	10:15	8	.....	10:15
21	7, 19, 31	6:15	.....	23	6:15	.....	9	6:15	.....
22	10, 18, 29	.....	10:15	.....	.....	.....	12	6:15	10;15
23	14	.....	2:15	.....	.....	.....	23	.....	2:15 & 10:15
24	6, 19	7	.....	23	7	.....	11	7	2
25	6	early till 8	.....	0	.....	.....	11	.....	5 till night.
26	30	6:30 till 10	.....	.....	.....	.....	.....	.....	.....
27	6	7 till 10	.....	.....	.....	.....	.....	.....	.....
28	6,7,8,9,10	6:30	.....	21	.....	10:30	9, 13	6:30	.....
29	5, 6, 7	.....	10:30	22	A. M.	P. M.	8, 21	.....	10:30
30	.....	.....	.....	23	7:30till 8:30	.....	22	6:30	2:30 & 10:30
31	6, 7, 9, 19	Morning.	.....	17	Noon.	.....	8, 11, 23	A. M.	P. M.
32	.....	.....	.....	.....	.....	.....	.....	.....	.....
33	6, 30	7	.....	0	.....	.....	11	7	.....
34	.....	.....	.....	.....	.....	.....	23	.....	2
35	4	.....	Night till	10	7	.....	11	7 till 11	.....
36	5	8	Night till	.....	.....	.....	23	.....	2
37	6	9;30	.....	.....	.....	.....	.....	.....	.....
38	30	early till 10	.....	.....	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....	.....	8	.....	5 till night.
40	.....	.....	.....	.....	.....	.....	11	.....	3 till 6
41	.....	.....	.....	.....	.....	.....	23	7 till	7
42	6, 30	7	.....	0	.....	.....	7, 8, 11, 23	7	.....
43	.....	.....	.....	.....	.....	.....	.....	.....	.....
44	30	Morning.	.....	.....	.....	.....	.....	.....	.....
45	6, 7, 19	.....	.....	0	.....	.....	.....	.....	.....
46	6, 7, 30	7	.....	0	.....	.....	11	7	.....
47	.....	.....	.....	.....	.....	.....	23	7	2
48	0	.....	.....	0	.....	.....	0	.....	.....
49	5,6,19,29,30	Morning.	.....	10	Morning	.....	23	A. M.	P. M.
50	7, 19	7	.....	10	7	.....	11, 13	7	.....
51	.....	.....	.....	.....	.....	.....	23	7	2
52	0	.....	.....	0	.....	.....	7, 9, 13	6:28	.....
53	.....	.....	.....	.....	.....	.....	.....	.....	.....
54	.....	.....	.....	.....	.....	.....	.....	.....	.....
55	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE VI.—*Average Per Cent of Cloudiness for the Year, and for each Month of the Year 1886, at each of 18 Stations in Michigan, and also the Average for the 18 Stations. Average of Observations made Daily at 7 A. M., 2 P. M. and 9 P. M.,* by Observers for the State Board of Health, † and for the U. S. Signal Service.*

Stations in Michigan.† (Those of the U. S. Signal Service in italics.)	Division of the State.‡	Average Per Cent of Cloudiness.												
		Year.		Months, 1886.										
		Norm. ‖	1886.	Jan.	Feb.	Mar.	Apr.	May.	J'ne.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 18 Stations..§	.....	.....	55	80	68	59	53	48	42	36	43	52	45	63	68
Marquette	U. P.	.....	60	84	73	58	51 j	52 b	56 e	42 c	48 g	61 d	48	69	74
Manistique and Gulliver Lake	U. P.	 7	49	68	56	53	51	43	39	33	42	48	36	59	60
Escanaba	U. P.	58 5	55	74	66 l	63 a	51 d	58 b	54 l	42 r	43 p	54 d	43	58 g	54 a
Traverse City	N. W.	60 3	58	90	76	65	57	46	42	43	53	60	44	36	81
Mackinaw City	N.	57 8	52	69	57	60	47	45	41	30	35	56	47	69	68
Alpena	N. E.	57 2	59	75	63	64	52	48	47	41	46	59	55	76	79
Harrisville	N. E.	60 8	60	85	64	64	61	55	44	40	48	52	55	70	78
Grand Haven	W.	58	58	85	73	58	59	49	30	28	43	60	55	74	77 e
Pentwater	W.	.....	56	88 c	82 k	58	56 q	51 b	34 f	27 l	34	54	38	69	81
Reed City	W.	.....	¶	77	70	56	69	41 b	36 t	45 j	..... d	h	b	.....	.....
East Saginaw	B. & E.	 8	54	74	64	57	55	42	38	33	43	53	51	63	73
Port Huron	B. & E.	57 10	53	79	67	59	49	47	41	35	42	50	48	65	58
Thornville	B. & E.	53 23	49	77	63	57	43	36	36	35	40	42	40	59	56
Agr'l College	C.	58	57	77	65	60 s	57	46	47	48	44	55	49	64	69
Ionia	C.	 8	**	79	71	78	56	.....	.....	38	39	43	39	55	68
Lansing, S. B. of H.	C.	56 3	58	80 a	66 m	63 a	56	50 h	48 g	40	46	56	50	67	68 a
Swartz Creek	C.	53	52	73 u	59	56 k	49 k	45 e	39 m	35 g	42 i	48 o	45 j	62 1	67 1
Otsego	S. W.	 7	39	85	63 j	45	39	30	27	20	19 a	30	21	40	53
Ann Arbor	S. C.	59	56	77 a	62 n	60	52	51	46	41	53	54	47 b	68 d	64 a
Battle Creek	S. C.	 10	††	83	74	.....	54	46	49	39	53 j	..... d	43 h	68 d	65 c
Kalamazoo	S. C.	68 6	61	91	80	66	71	62	56	27	48 a	52	43	66	69
Marshall	S. C.	55	50	78 b	67 j	52 b	52 f	42 b	36 d	28	45	45	34 f	62 1	61 d
Birmingham	S. E.	 8	§§	75	69	61	51	51	47	.....	.....	.....	46	68	61
Detroit	S. E.	56	54	77	68	58	50	46	41	40	46	49	40	65	64

*At stations of the U. S. Signal Service the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th meridian time. The corresponding local time for each of these stations is stated in the star (*) foot note to Table I., page 47.

† The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit 1, page 30.

‡ The full names of divisions and the counties in each division are stated in Exhibit I, in a paper which follows, on weekly reports of sickness.

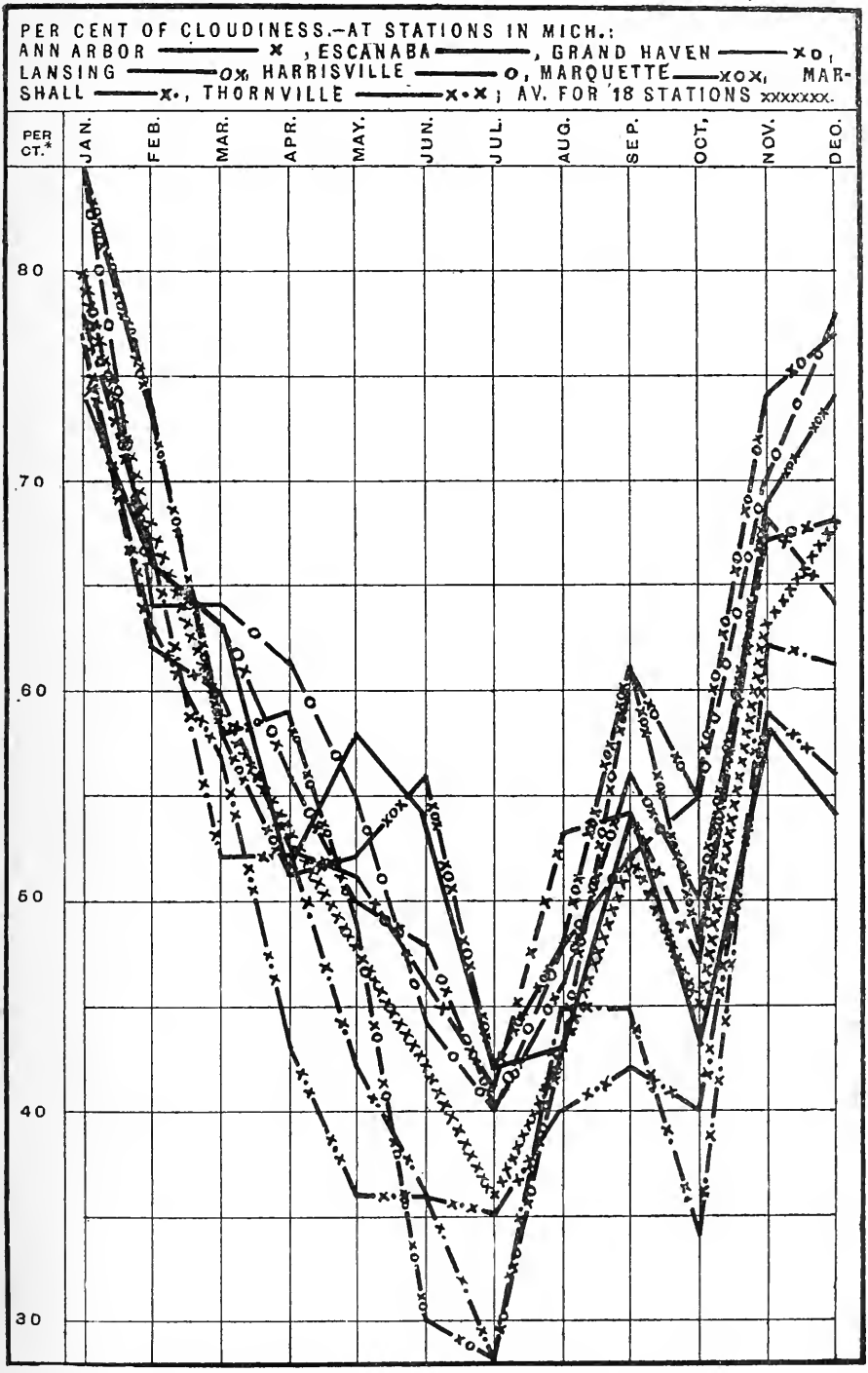
‖ Numbers in this column state the average per cent of cloudiness for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the per cent of cloudiness, denote the number of years included in the average.

NOTE TO TABLE VI.—Computations of average per cent of cloudiness for 1886 were made and furnished by the observers at Marquette, April, June, August, September, November and December excepted; Mackinac City, Alpena, Grand Haven, Port Huron, November and December excepted, and Ann Arbor for each month in 1886. All other computations in Table VI. were made at the office of the State Board of Health.

§ This line is an average for only the stations from which statements, nearly complete, were received for every month of the year. It does not include the line for Manistique and Gulliver Lake, Reed City, Ionia, Swartz Creek, Battle Creek and Birmingham.

Footnotes to Table VI. are printed at bottom of page 69.

DIAGRAM VI.–AV. PER CT. OF CLOUDINESS, MOS., 1886.



*SCALE, TEN PER CENT TO 1.12. IN. VERTICALLY.

H. B. T. DEL. DES. BY H. B. B.

EXHIBIT 18.—*Average Per Cent of Cloudiness, by Year and Months, in 1886, Compared with Annual and Monthly Average for 1885, and for the ten Years 1877–86. These Averages are for Groups of several Stations in Michigan.**

Years, Etc.	Per Cent of Cloudiness.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 yrs., 1877-86*.	56	69	62	60	52	48	47	42	43	46	56	68	77
1885 (20 stations.*)..	57	67	57	51	58	50	41	41	54	44	59	84	81
1886 (18 stations.*)..	55	80	68	59	53	48	42	36	43	52	45	63	68
In 1886 **Greater** than Av. for 10 yrs. 1877-86.	.....	11	6	.....	1	0	.....	.....	0	6	.....	.....	.....
In 1886 **Less** than Av. for 10 yrs., 1877-86.	1	.....	.....	1	.....	0	5	6	0	.....	11	5	9
In 1886 **Greater** than in 1885.	.....	13	11	8	.....	.....	1	.....	.....	8	.....	.....	.....
In 1886 **Less** than in 1885	2	.....	.....	.....	5	2	.....	5	11	.....	14	21	13

*Thornville, Kalamazoo, for 1877–86; Mendon for 1877–83; Tecumseh for 1877-85; Battle Creek for 1877–80 and 1882–85; Nirvana for 1877-9 and for first four months of 1880; Reed City for last eight months of 1880, and 1881-5; Detroit for 1877 and 1879-86; Niles for 1878–81; Benton Harbor for 1877–8 and 1880; Coldwater, Woodmere Cemetery (near Detroit) for 1877-9; Otisville for 1878–80 and 1882; Marquette for 1879–84 and 1886; Alpena, Grand Haven, Port Huron, Lansing for 1879–86; Washington for 1879–83; Ypsilanti for 1877 and 1879; Agricultural College for 1877 and 1881–6; Petoskey for 1878–9; Escanaba, Ann Arbor for 1880-6; Fife Lake for 1877; Ionia for 1880 and 1883–5; Adrian for 1880; Hillsdale for 1880 and 1882–4; Marshall for 1881–6; Parkville for 1881–2: Winfield for 1881 and 1883; Hudson and Mallory Lake for 1881; Harrisville for 1882 and 1885–6; Hastings for 1882; Traverse City for 1882–6; Port Austin for 1883; Manistique, Swartz Creek for 1884–5; Mackinaw City 1884–6; Pentwater, East Saginaw, Otsego for 1886.

EXHIBIT 19.—*Comparison of the Average Per Cent of Cloudiness in the Year and each Month of the Year 1886, with Averages for the Twenty-two Years, 1864–85, and for the Year 1885. Observations made at 7 A. M., 2 P. M., and 9 P. M., Daily, by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Mich.*

Years, Etc.	Per Cent of Cloudiness.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 22 years, 1864-85	58	72	64	63	56	51	50	46	47	49	59	67	77
1885.....	58	75	49	52	60	55	43	43	52	44	60	79	82
1886.....	57	77	65	60	57	46	47	48	44	55	49	64	69
In 1886 **Greater** than Av. for 22 yrs, 1864-85.....	.....	5	1	.....	1	.....	.....	2	.....	6	.....	.....	.....
In 1886 **Less** than Av. for 22 yrs., 1864-85.....	1	.....	.....	3	.....	5	3	.....	3	.....	10	3	8
In 1886 **Greater** than in 1885.....	.....	2	16	8	.....	.....	4	5	.....	11	.....	.....	.....
In 1886 **Less** than in 1885.....	1	.....	.....	.....	3	9	.....	.....	8	.....	11	15	13

EXHIBIT 20.—*Dates of Auroras Observed and Recorded at Eleven Stations in Michigan during the Year 1886.*

Stations.	Dates of Auroras Recorded in 1886.											
	Jan.	Feb.	March.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Marquette	.....	.....	26,27	.....	14	.....	.....	.....	.....	7,9,18 21, 28, 29, 30	.....	29
Manistique	28,29,30	7	10, 11, 12, 22, 26, 28	5,6,20	.....	.....	.....	.....	.....	.....	.....	.....
Gulliver Lake	.....	.....	.....	.....	.....	.....	22	.....	20	9,18,21 26, 27, 28, 29	3,15,23	14, 15, 17, 27, 28,29
Escanaba	29	3,4,7	22,26,27	4,5	.....	5	2	23,24	*10,11,20	26,27	3,4,23	1,2
	.....	.....	.....	12,20	.....	.....	.....	.....	.....	28,29,30	24,29,30	28,29
Traverse City	.....	.....	.....	14	.....	.....	.....	.....	.....	.....	.....	.....
Mack'w City	29	7,8	26,27	4,20	1,2	5,29	19,22,27	13,14	20,21,30	1,7,26	5,25	28,29
	.....	.....	.....	21,30	20,21	.....	.....	17,23	.....	27,28,29	29,30	.....
Alpena	.....	.....	.....	20,21	1	29	27	.....	20	.....	.....	.....
G'd Haven	.....	.....	.....	.....	.....	24,25	27	.....	.....	.....	.....	.....
Swartz Creek	.....	.....	.....	20	.....	.....	.....	.....	.....	.....	.....	.....
Ann Arbor	.....	.....	.....	20	.....	.....	.....	.....	.....	.....	.....	.....
Kalamazoo	.....	.....	.....	.....	.....	.....	.....	.....	27	.....	.....	.....

*Saint Elmo Fire Sept. 24: Reported by Capt. J. S. Church of Schooner J. S. Richardson.

METEORS.

Meteors observed Aug. 2, 7, 11, 25, 27, 28, 30.—*Kalamazoo.*

Sept. 4, six meteors observed between 8:35 P. M. and 1:50 A. M. of the 26th.—*Kalamazoo.*

Sept. 28, meteor seen; course from S. E. to N. W.—*Kalamazoo.*

Oct. 30, meteor seen.—*Mackinaw City.*

Oct. 2, meteor seen at 7:05 P. M., course from north to south, low down.—*Kalamazoo.*

Nov. 3, three meteors seen at 11:10 P. M., course east to west, and three at 11:15 P. M., course east to west.—*Kalamazoo.*

Oct. 18, meteor seen at 9:15 P. M., course north, bright red and blue light. Lasted 4 seconds.—*Gulliver Lake.*

April 22, meteor seen at 9:20 P. M., unusually bright, course downward and southwesterly, leaving a track of bright light.—*Lansing.*

Foot-notes from page 66.]

¶ The average for 7 months in 1886 is 56. ** For 10 months, 57. †† For 10 months, 57. §§ For 9 months, 59.

a, b, c. In the columns from January to December, inclusive, the letters a, b, c, etc., stand directly above the numbers from which they refer to the notes below.

a For 92 observations. b For 91 observations. c For 90 observations. d For 89 observations.
e For 88 observations. f For 87 observations. g For 86 observations. h For 85 observations.
i For 84 observations. j For 83 observations. k For 82 observations. l For 81 observations.
m For 80 observations. n For 79 observations. o For 78 observations. p For 76 observations.
q For 73 observations. r For 70 observations. s For 63 observations. t For 60 observations.
u For 35 observations.

¶¶ The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer at Gulliver Lake, Gulliver Lake is about 12 miles east from Manistique.

Graphic representations of 8 representative lines in this table are given in Diagram No. VI., page 67.

The following is a statement of the days in each month in 1886 which were "all or nearly all sunshine," and the days "all or nearly all cloudy," as reported by the observers at stations in Michigan.

LANSING.

JAN.—Sunny, 6, 11, 12, 13, 14, 21, 23, 24, 31—9 days. Cloudy, 1, 2, 3, 4, 5, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 28, 29, 30—22 days.

FEB.—Sunny, 2, 3, 4, 7, 8, 16, 20, 23, 24, 26, 27, 28—12 days. Cloudy, 1, 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 21, 22, 25—16 days.

MARCH.—Sunny 1, 2, 4, 5, 6, 7, 10, 18, 23, 24, 25, 26, 27—13 days. Cloudy, 3, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 28, 29, 30, 31—18 days.

APRIL.—Sunny, 2, 3, 4, 5, 7, 8, 13, 16, 18, 19, 20, 21, 22, 23, 27, 29—16 days. Cloudy, 1, 6, 9, 10, 11, 12, 14, 15, 17, 24, 25, 26, 28, 30—14 days.

MAY.—Sunny, 2, 5, 6, 7, 11, 12, 13, 16, 17, 19, 20, 21, 22, 25, 27, 28, 30, 31—18 days. Cloudy, 1, 3, 4, 8, 9, 10, 14, 15, 18, 23, 24, 26, 29—13 days.

JUNE.—Sunny, 3, 4, 5, 6, 7, 8, 9, 10, 12, 16, 17, 18, 19, 20, 21, 27, 28, 29, 30—19 days. Cloudy, 1, 2, 11, 13, 14, 15, 22, 23, 24, 25, 26—11 days.

JULY.—Sunny, 3, 4, 5, 6, 7, 8, 10, 11, 15, 16, 17, 18, 21, 22, 23, 25, 27, 28—18 days. Cloudy, 1, 2, 9, 12, 13, 14, 19, 20, 24, 26—10 days. No record given for the rest of the month.

AUGUST.—Sunny, 2, 3, 4, 6, 7, 8, 9, 12, 14, 15, 16, 17, 18, 19, 25, 26, 27, 31—18 days. Cloudy, 1, 5, 10, 13, 20, 21, 22, 23, 24, 28, 29, 30—13 days.

SEPT.—Sunny, 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 17, 18, 20, 24, 25, 29—19 days. Cloudy, 4, 9, 16, 19, 21, 22, 23, 26, 27, 28, 30—11 days.

OCT.—Sunny, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 18, 19, 21, 22, 23, 24, 30, 31—20 days. Cloudy, 1, 4, 14, 16, 17, 20, 25, 26, 27, 28, 29—11 days.

NOV.—Sunny, 1, 2, 8, 11, 13, 14, 15, 19, 20, 21—10 days. Cloudy, 3, 4, 5, 6, 7, 9, 10, 12, 16, 17, 18, 22, 23, 24, 25, 26, 27, 28, 29, 30—20 days.

DEC.—Sunny, 4, 5, 6, 7, 8, 9, 20, 22, 30—9 days. Cloudy, 1, 2, 3, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 23, 24, 25, 26, 27, 28, 29, 31—22 days.

MARQUETTE.

JAN.—Sunny, 23—1 day. Cloudy, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 29, 30—23 days. No record for the rest of the month.

FEB.—Sunny, 2—1 day. Cloudy 5, 6, 9, 10, 11, 13, 14, 15, 17, 18, 19, 22, 24, 25, 28—15 days. No record for the rest of the month.

MARCH.—Sunny, 2, 4, 5, 9, 10, 23, 25—7 days. Cloudy, 7, 8, 12, 17, 18, 19, 20, 21, 24, 29, 31—11 days. No record for the rest of the month.

APRIL.—Sunny, 3, 4, 5, 7, 8, 12, 13, 18, 19, 21, 22, 28, 29, 30—14 days. Cloudy, 1, 2, 6, 9, 10, 11, 14, 15, 16, 17, 20, 23, 24, 25, 26, 27—16 days.

MAY.—Sunny, 1, 3, 6, 16, 20, 24, 25, 27, 30—9 days. Cloudy, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 21, 22, 23, 26, 28, 29, 31—22 days.

JUNE.—Sunny, 7, 10, 18, 27, 28, 29, 30—7 days. Cloudy, 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26—23 days.

JULY.—Sunny, 6, 14—2 days. Cloudy, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31—29 days.

ESCANABA.

JAN.—Cloudy, 2, 3, 4, 5, 6, 8, 9, 16, 17, 18, 20, 24, 25, 26, 29, 30—16 days. No record for the rest of the month.

FEB.—Sunny, 2, 3, 4, 8, 26—5 days. Cloudy, 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20, 22, 24—14 days. No record for the rest of the month.

MARCH.—Sunny, 1, 2, 4, 5, 9, 10, 25, 26—8 days. Cloudy, 7, 8, 11, 14, 15, 17, 18, 19, 20, 21, 24, 28, 29, 30, 31—15 days. No record for the rest of the month.

APRIL.—Sunny, 3, 4, 5, 7, 8, 13, 17, 18, 19—9 days. Cloudy, 9, 10, 11, 14, 15, 23, 24, 25, 26, 27—10 days. No record for the rest of the month.

MAY.—Sunny, 16, 19, 26, 25—4 days. Cloudy, 8, 9, 10, 14, 17, 23, 26, 31—8 days. No record for the rest of the month.

JUNE.—Sunny, 3, 7, 10, 18, 27, 28, 29, 30—8 days. Cloudy, 1, 4, 11, 15, 16, 19, 23, 24—8 days. No record for the rest of the month.

JULY.—Sunny, 1, 2, 3, 5, 6, 14, 18, 20, 21, 23—10 days. Cloudy, 13, 25, 31—3 days. No record for the rest of the month.

AUG.—Sunny, 1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 17, 18, 23, 24, 25, 26, 29, 30, 31—19 days. Cloudy, 4, 6, 13, 14, 15, 16, 19, 20, 21, 22, 27, 28—12 days.

SEPT.—Sunny, 1, 4, 5, 6, 7, 13, 14, 20, 26, 28—10 days. Cloudy, 2, 3, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19, 21, 22 23, 24, 25, 27, 29, 30—20 days.

OCT.—Clear, 1, 2, 4, 5, 6, 7, 21, 22, 26, 27, 28, 29, 30—13 days. Fair, 3, 8, 9, 10, 13, 15, 19, 20, 25, 31—10 days. Cloudy, 11, 12, 14, 16, 17, 18, 23, 24—8 days.

DEC.—Sunny, 1, 2, 3, 7, 15, 16, 17, 18, 19, 21, 22, 24, 25, 27, 28—15 days. Cloudy, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 20, 23, 26, 29, 30, 31—16 days.

MACKINAW CITY.

JAN.—Clear, 6, 7, 11, 31—4 days. Fair, 5, 8, 9, 10, 14, 17, 19, 21, 23, 27, 28, 29, 30—13 days. Cloudy, 1, 2, 3, 4, 12, 13, 15, 16, 18, 20, 22, 24, 25, 26—14 days.

FEB.—Clear, 2, 3, 4, 8, 26, 27—6 days. Fair, 7, 14, 15, 16, 19, 20, 21, 22, 23, 25, 28—11 days. Cloudy, 1, 5, 6, 9, 10, 11, 13, 17, 18, 24—10 days. Foggy, 1 day.

MARCH.—Clear, 1, 4, 5, 10, 23, 25, 27—7 days. Fair, 2, 6, 7, 9, 12, 14, 15, 16, 22, 24, 26, 28—12 days. Cloudy, 3, 8, 11, 13, 17, 18, 19, 20, 21, 29, 30, 31—12 days.

APRIL.—Clear, 4, 5, 7, 8, 19, 21, 22, 28, 30—9 days. Fair, 1, 2, 3, 6, 9, 10, 12, 13, 14, 15, 17, 18, 20, 23, 29—15 days. Cloudy, 11, 16, 24, 25, 26, 27—6 days.

MAY.—Clear, 20, 22, 23, 24, 28, 29, 30—7 days. Fair, 1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 15, 16, 17, 18, 19, 21, 25, 26, 27—20 days. Cloudy, 8, 10, 14, 31—4 days.

JUNE.—Clear, 3, 14, 18, 21, 22, 26, 27, 28, 29, 30—10 days. Fair, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 15, 17, 19, 20, 23, 24, 25—17 days. Cloudy, 1, 11, 16—3 days.

JULY.—Clear, 1, 2, 3, 4, 5, 6, 11, 12, 14, 15, 18, 22, 23, 26, 27, 30—16 days. Fair, 7, 8, 9, 10, 13, 16, 19, 20, 21, 24, 29, 31—12 days. Cloudy, 17, 25, 28—3 days.

AUG.—Clear, 2, 3, 4, 5, 7, 8, 9, 11, 12, 14, 18, 19, 23, 24, 25, 26, 27—17 days. Fair, 1, 6, 10, 13, 15, 17, 22, 30, 31—9 days. Cloudy, 16, 20, 21, 28, 29—5 days.

SEPT.—Clear, 1, 5, 7, 14, 15, 29—6 days. Fair, 2, 3, 4, 6, 11, 12, 13, 17, 19, 20, 22, 23, 26, 28, 30—15 days. Cloudy, 8, 9, 10, 16, 18, 21, 24, 25, 27—9 days.

OCT.—Clear, 2, 5, 7, 8, 19, 22, 26, 27, 28, 29, 30—11 days. Fair, 4, 9, 10, 13, 15, 16, 18, 20, 21, 25, 31—11 days. Cloudy, 1, 3, 6, 11, 12, 14, 17, 23, 24—9 days.

NOV.—Clear, 2, 14—2 days. Fair, 1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 21, 29—15 days. Cloudy, 10, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30—13 days.

DEC.—Clear, 24, 30—2 days. Fair, 2, 3, 10, 11, 14, 15, 17, 18, 19, 21, 22, 25, 26, 27, 28, 29—16 days. Cloudy, 1, 4, 5, 6, 7, 8, 9, 12, 13, 16, 20, 23, 31—13 days.

GRAND HAVEN.

JAN.—Sunny, 6, 7, 14, 21, 24, 27, 31—7 days. Cloudy, 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22, 23, 25, 26, 28, 29, 30—24 days.

FEB.—Sunny, 3, 4, 8, 23, 26—5 days. Cloudy, 1, 2, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 27, 28—23 days.

MARCH.—Sunny, 1, 2, 3, 4, 5, 6, 7, 10, 16, 23, 24, 26, 27—13 days. Cloudy, 8, 9, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 25, 28, 29, 30, 31—18 days.

APRIL.—Sunny, 2, 3, 4, 5, 7, 8, 13, 17, 18, 19, 20, 21, 22, 27, 28, 30—16 days. Cloudy, 1, 6, 9, 10, 11, 12, 14, 15, 16, 23, 24, 25, 26, 29—14 days.

MAY.—Sunny, 2, 3, 5, 6, 7, 11, 16, 17, 19, 20, 21, 25, 31—13 days. Clear, 28—1 day. Cloudy, 1, 4, 8, 9, 10, 12, 13, 14, 15, 18, 22, 23, 24, 26, 27, 29, 30—17 days.

JUNE.—Sunny, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29, 30—23 days. Cloudy, 1, 2, 13, 15, 16, 23, 24—7 days.

JULY.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 21, 22, 23, 27, 28, 31—22 days. Cloudy, 9, 13, 19, 20, 24, 25, 26, 29, 30—9 days.

SEPT.—Sunny, 1, 3, 5, 6, 7, 10, 11, 12, 14, 15, 17, 18, 19, 20, 22, 25, 28, 29—18 days. Cloudy, 2, 4, 8, 9, 13, 16, 21, 23, 24, 26, 27, 30—12 days.

OCT.—Sunny, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 18, 19, 20, 21, 22, 24, 25, 26, 29, 30, 31—21 days. Cloudy, 1, 3, 13, 14, 15, 16, 17, 23, 27, 28—10 days.

ALPENA.

FEB.—Sunny, 2, 3, 4, 7, 8, 12, 16, 20, 23, 27, 28—11 days. Cloudy, 1, 5, 6, 9, 10, 11, 13, 14, 15, 17, 18, 19, 21, 22, 24, 25, 26—17 days.

MARCH.—Sunny, 1, 4, 5, 6, 9, 10, 12, 16, 23, 24, 25, 26, 27—13 days. Cloudy, 2, 3, 7, 8, 11, 13, 14, 15, 17, 18, 19, 20, 21, 22, 28, 29, 30, 31—18 days.

APRIL.—Sunny, 2, 3, 4, 5, 7, 8, 13, 14, 18, 19, 20, 21, 22, 27, 28, 29—16 days. Cloudy, 1, 6, 9, 10, 11, 12, 15, 16, 17, 23, 24, 25, 26, 30—14 days.

MAY.—Sunny, 1, 2, 5, 6, 7, 8, 16, 17, 19, 20, 22, 23, 24, 25, 27, 29, 30, 31—18 days. Cloudy, 3, 4, 9, 10, 11, 12, 13, 14, 15, 18, 21, 26, 28—13 days.

JUNE—Sunny, 3, 4, 5, 6, 8, 10, 11, 13, 14, 17, 18, 19, 20, 26, 27, 28, 29, 30—18 days. Cloudy, 1, 2, 7, 9, 12, 15, 16, 21, 22, 23, 24, 25—12 days.

JULY.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 15, 20, 21, 22, 23, 26, 27, 29, 30—20 days. Cloudy, 9, 13, 14, 16, 17, 18, 19, 24, 25, 28, 31—11 days.

AUG.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 18, 19, 24, 25, 26, 27, 30—20 days. Cloudy, 13, 15, 16, 17, 20, 21, 22, 23, 28, 29, 31—11 days.

SEPT.—Sunny,—1, 2, 3, 5, 6, 7, 11, 13, 14, 15, 17, 20, 23, 28, 29—15 days. Cloudy, 4, 8, 9, 10, 12, 16, 18, 19, 21, 22, 24, 25, 26, 27, 30—15 days.

OCT.—Sunny, 2, 3, 5, 6, 7, 8, 9, 10, 19, 21, 22, 23, 26, 27, 29, 30, 31—17 days. Cloudy, 1, 4, 11, 12, 13, 14, 15, 16, 17, 18, 20, 24, 25, 28—14 days.

DEC.—Sunny, 4, 9, 16, 22, 27, 28, 29—7 days. Cloudy, 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 23, 24, 25, 26, 30, 31—24 days.

PENTWATER.

JAN.—Sunny, 6, 7, 14, 28—4 days. Cloudy, 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 31—27 days.

FEB.—Sunny, 3, 4, 7, 8, 23—5 days. Cloudy, 1, 2, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28—23 days.

MARCH.—Sunny, 1, 2, 3, 4, 5, 6, 7, 10, 16, 17, 23, 24, 26, 27—14 days. Cloudy, 8, 9, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 25, 28, 29, 30, 31—17 days.

APRIL.—Sunny, 2, 3, 4, 5, 7, 8, 18, 19, 20, 21, 22, 28, 30—13 days. Cloudy, 1, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 23, 24, 25, 26, 27, 29—17 days.

MAY.—Sunny, 2, 3, 5, 7, 8, 13, 16, 17, 19, 20, 21, 22, 23, 24, 25, 27, 28, 29, 31—19 days. Cloudy, 1, 4, 6, 9, 10, 11, 12, 14, 15, 18, 26, 30—12 days.

JUNE.—Sunny, 3, 4, 7, 8, 9, 10, 12, 14, 17, 18, 19, 20, 21, 22, 23, 26, 27, 28, 29, 30—20 days. Cloudy, 1, 2, 5, 6, 11, 13, 15, 16, 24, 25—10 days.

JULY.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 14, 15, 16, 18, 20, 21, 22, 23, 26, 27, 28, 29, 31—23 days. Cloudy, 9, 12, 13, 17, 19, 24, 25, 30—8 days.

AUG.—Sunny, 1, 2, 3, 4, 7, 8, 9, 10, 12, 14, 15, 17, 18, 24, 25, 26, 27, 28, 29, 30, 31—21 days. Cloudy, 5, 6, 11, 13, 16, 19, 20, 21, 22, 23—10 days.

SEPT.—Sunny, 1, 3, 4, 5, 6, 7, 10, 14, 15, 17, 20, 25, 28, 29—14 days. Cloudy, 2, 8, 9, 11, 12, 13, 16, 18, 19, 21, 22, 23, 24, 26, 27, 30—16 days.

OCT.—Sunny, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 19, 21, 22, 26, 27, 29, 30, 31—18 days. Cloudy, 1, 12, 13, 14, 15, 16, 17, 18, 20, 23, 24, 25, 28—13 days.

NOV.—Sunny, 3, 6, 8, 12, 14, 15, 16, 19, 21—9 days. Cloudy, 1, 2, 4, 5, 7, 9, 10, 11, 13, 17, 18, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30—21 days.

DEC.—Sunny, 4, 7, 9, 10, 22, 30—6 days. Cloudy, 1, 2, 3, 5, 6, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29—24 days.

EAST SAGINAW.

JAN.—Sunny, 6, 13, 14, 21, 24, 31—6 days. Partly cloudy, 12, 23—2 days. Cloudy, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 28, 29, 30—23 days.

FEB.—Sunny, 2, 3, 4, 8, 16, 20, 23, 26—8 days. Partly sunny, 1, 9, 10, 11—4 days. Cloudy, 5, 6, 7, 12, 13, 14, 15, 17, 18, 19, 21, 22, 25, 27, 28—15 days. Partly cloudy, 24—1 day.

MARCH.—Sunny, 1, 2, 4, 5, 6, 7, 10, 23, 25, 26, 27—11 days. Cloudy, 3, 8, 9, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 24, 28, 29, 30, 31—18 days. Partly cloudy, 16, 17—2 days.

APRIL.—Sunny, 4, 5, 7, 8, 15, 19, 20, 21, 22—9 days. Partly sunny, 3, 9—2 days. Cloudy, 1, 2, 6, 10, 11, 12, 13, 14, 24, 25, 26, 30—12 days. Partly cloudy, 16, 17, 18, 23, 27, 28, 29—7 days.

MAY.—Sunny, 2, 5, 7, 8, 12, 17, 19, 20, 21, 22, 28, 30, 31—13 days. Partly sunny, 1, 3, 14, 16, 24, 27—6 days. Cloudy, 4, 9, 10, 11, 15, 18, 26—7 days. Partly cloudy, 6, 13, 23, 25, 29—5 days.

JUNE.—Sunny, 4, 7, 8, 10, 11, 12, 14, 15, 26, 27, 28, 29—12 days. Partly sunny, 2—1 day. Cloudy, 13, 24, 25—3 days. Partly cloudy, 1, 3, 5, 9, 23—5 days. No record for the rest of the month.

JULY.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 15, 16, 20, 21, 22, 23, 27, 28, 29, 31—20 days. Partly sunny, 17, 18,

24, 25—4 days. Cloudy, 9, 11, 13, 14, 26—5 days. Partly cloudy, 19, 30—2 days.

AUG.—Sunny, 3, 6, 7, 8, 9, 10, 12, 13, 14, 15, 18, 19, 25, 26, 27, 28—16 days. Partly sunny, 1, 5—2 days. Cloudy, 4, 16, 21, 22, 23, 29—6 days. Partly cloudy, 2, 11, 17, 20, 24, 30, 31—7 days.

SEPT.—Sunny, 1, 2, 3, 4, 5, 6, 7, 10, 14, 17, 18, 20, 28, 29—14 days. Partly sunny, 8, 23—2 days. Cloudy, 9, 12, 13, 15, 16, 19, 21, 22, 24, 27, 30—11 days. Partly cloudy, 11, 25, 26—3 days.

OCT.—Sunny, 2, 5, 6, 7, 8, 9, 10, 11, 19, 21, 30, 31—12 days. Partly sunny, 3, 23—2 days. Cloudy, 1, 4, 14, 15, 16, 17, 18, 20, 22, 25, 26, 27, 28, 29—14 days. Partly cloudy, 12, 13, 24—3 days.

NOV.—Sunny, 1, 2, 8, 13, 14, 15, 21—7 days. Partly sunny, 6, 7, 29—3 days, Cloudy, 4, 9, 10, 12, 17, 18, 19, 22, 23, 24, 25, 26, 27, 28, 30—15 days. Partly cloudy, 3, 5, 11, 16, 20—5 days.

DEC.—Sunny, 4, 5, 6, 9, 10, 22—6 days. Partly sunny, 7, 24—2 days. Cloudy, 1, 2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 26, 29, 30, 31—21 days. Partly cloudy, 27, 28—2 days.

PORT HURON.

JAN.—Clear, 13—1 day. Fair, 1, 10, 11, 14, 19, 22, 23, 24, 31—9 days. Cloudy, 2, 3, 4, 5, 6, 7, 8, 9, 12, 15, 16, 17, 18, 20, 21, 25, 26, 27, 28, 29, 30—21 days.

FEB.—Clear, 8—1 day. Fair, 2, 3, 4, 9, 15, 16, 17, 20, 22, 23, 24, 26, 27, 28—14 days. Cloudy, 1, 5, 6, 7, 10, 1, 12, 13, 14, 18, 19, 21, 25—13 days.

MARCH.—Clear, 2, 5, 6, 10, 26—5 days. Fair, 1, 3, 4, 7, 11, 14, 15, 16, 17, 23, 24, 25, 27, 28, 29, 31—16 days. Cloudy, 8, 9, 12, 13, 18, 19, 20, 21, 22, 30—10 days.

APRIL.—Clear, 8, 14, 15, 16, 17, 19, 20, 21, 22, 27, 29—11 days. Fair, 3, 4, 5, 7, 9, 12, 13, 18, 23, 24, 25, 28—12 days. Cloudy, 1, 2, 6, 10, 11, 26, 30—7 days.

MAY.—Clear, 2, 17, 19, 20, 22, 28, 31—7 days. Fair, 1, 3, 4, 5, 6, 7, 8, 11, 12, 13, 16, 18, 21, 23, 24, 25, 26, 29, 30—19 days. Cloudy, 9, 10, 14, 15, 27—5 days.

JUNE.—Clear, 3, 4, 5, 6, 8, 12, 14, 18, 19, 26, 28, 29, 30—13 days. Fair, 1, 2, 7, 10, 11, 13, 15, 16, 23, 25, 27—11 days. Cloudy, 9, 17, 20, 21, 22, 24—6 days.

JULY.—Clear, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 16, 21, 23, 27, 31—16 days. Fair, 18, 19, 20, 22, 24, 25, 26, 28, 30—9 days. Cloudy, 9, 13, 14, 15, 17, 29—6 days.

AUG.—Clear, 2, 6, 7, 8, 12, 19, 25, 26, 27, 28, 31—11 days. Fair, 1, 3, 4, 5, 9, 10, 11, 14, 15, 18, 20, 23, 29, 30—14 days. Cloudy, 13, 16, 17, 21, 22, 24—6 days.

SEPT.—Clear, 1, 2, 5, 6, 7, 14, 20, 29.—8 days. Fair, 3, 4, 8, 10, 11, 12, 13, 15, 17, 18, 21, 23, 25, 27—14 days. Cloudy, 9, 16, 19, 22, 24, 26, 28, 30—8 days.

ANN ARBOR.

JAN.—Sunny, 6, 13, 14, 21, 23, 24, 31—7 days. Cloudy, 2, 3, 4, 5, 8, 9, 10, 11, 15, 16, 17, 18, 20, 22, 25, 26, 27, 28, 29—19 days. No record for the rest of the month.

FEB.—Sunny, 4, 8, 9, 10, 20, 23, 24, 26, 27—9 days. Cloudy, 1, 5, 6, 7, 12, 13, 14, 15, 18, 19, 21, 25—12 days. No record for the rest of the month.

MARCH.—Sunny, 1, 2, 3, 4, 5, 6, 7, 10, 23, 24, 26, 27, 28—12 days. Cloudy, 8, 9, 13, 14, 17, 20, 21, 22, 25, 29, 30, 31—12 days. No record for the rest of the month.

APRIL.—Sunny, 3, 7, 8, 14, 16, 17, 18, 19, 20, 21, 22, 23, 27, 28, 29—15 days. Cloudy, 1, 6, 10, 12, 26, 30—6 days. No record for the rest of the month.

MAY.—Sunny, 2, 3, 5, 6, 7, 8, 11, 12, 13, 17, 18, 19, 20, 21, 22, 31—16 days. Cloudy, 1, 4, 9, 10, 14, 15, 24, 26—8 days. No record for the rest of the month.

JUNE.—Sunny, 3, 4, 6, 7, 8, 12, 15, 16, 17, 18, 19, 20, 26, 27, 28, 29, 30—17 days. Cloudy, 13, 21, 24, 25—4 days. No record for the rest of the month.

JULY.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 22, 23, 24, 27, 28, 31—16 days. Cloudy, 26, 30—2 days. No record for the rest of the month.

AUG.—Sunny, 2, 3, 7, 8—4 days. Cloudy, 4, 5—2 days. No record for the rest of the month.

SEPT.—Sunny, 5, 6, 7, 14, 17, 24, 25, 29—8 days. Cloudy, 9, 16, 21, 22, 23, 26, 27, 28, 30—9 days.

OCT.—Sunny, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 18, 19, 21, 22, 24, 30, 31—17 days. Cloudy, 1, 4, 14, 15, 16, 17, 20, 25, 26, 27, 28, 29—12 days. No record for the rest of the month.

NOV.—Sunny, 1, 3, 7, 8, 13, 14, 15, 16, 19, 21—10 days. Cloudy, 6, 9, 10, 12, 17, 18, 22, 23, 24, 25, 26, 27, 28, 29, 30—15 days. No record for the rest of the month.

DEC.—Sunny, 5, 6, 8, 9, 10, 11—6 days. Cloudy, 1, 2, 3, 4, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31—22 days. No record for the rest of the month.

BIRMINGHAM.

JAN.—Sunny, 6—1 day. Cloudy, 1, 2, 3, 4, 5, 7, 8—7 days. No record for the rest of the month.

FEB.—Sunny, 2, 4, 8, 9, 20, 23, 24, 26, 27, 28—10 days. Cloudy, 1, 3, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 25—18 days.

MARCH.—Sunny, 1, 2, 4, 5, 6, 7, 10, 16, 23, 25, 26, 27—12 days. Cloudy, 3, 8, 9, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 24, 28, 29, 30, 31—19 days.

APRIL.—Sunny, 3, 4, 7, 8, 14, 16, 17, 18, 19, 20, 21, 22, 27, 28, 29—15 days. Cloudy, 1, 2, 5, 6, 9, 10, 11, 12, 13, 15, 23, 24, 25, 26, 30—15 days.

KALAMAZOO.

JUNE.—Sunny, 24, 25, 26, 27, 28, 29, 30—7 days. No record for the rest of the month.

JULY.—Sunny, 5, 6, 7, 8, 9, 10, 12, 16, 18, 21, 22, 23, 24, 27, 28, 29, 31—17 days. Cloudy, 1, 2, 3, 4, 11, 13, 14, 15, 17, 19, 20, 25, 26, 30—14 days.

AUG.—Sunny, 1, 2, 3, 7, 8, 9, 16, 18, 19, 25, 26, 27, 30, 31—14 days. Cloudy, 4, 5, 6, 10, 11, 12, 13, 14, 15, 17, 20, 21, 22, 23, 24, 28, 29—17 days.

SEPT.—Sunny, 5, 6, 7, 8, 10, 11, 14, 15, 17, 18, 20, 24, 28, 29—14 days. Cloudy, 1, 2, 3, 4, 9, 12, 13, 16, 19, 21, 22, 33, 25, 26, 27, 30—16 days.

OCT.—Sunny, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 15, 19, 21, 22, 23, 24, 30, 31—19 days. Cloudy, 1, 6, 14, 16, 17, 18, 20, 25, 26, 27, 28, 29—12 days.

NOV.—Sunny, 1, 2, 4, 6, 8, 11, 13, 14, 15, 20, 21, 29—12 days. Cloudy, 3, 5, 7, 9, 10, 12, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27, 28, 30—18 days.

DEC.—Sunny, 3, 4, 5, 6, 7, 8, 9, 22—8 days. Cloudy, 1, 2, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31—23 days.

THORNVILLE.

JAN.—Sunny, 13, 14, 21, 23, 24, 31—6 days. Cloudy, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 28, 29, 30—23 days. No record for the rest of the month.

FEB.—Sunny, 2, 4, 8, 9, 11, 16, 20, 23, 26, 27—10 days. Cloudy, 1, 3, 5, 6, 7, 12, 13, 14, 15, 18, 19, 21, 23, 25—14 days. No record for the rest of the month.

MARCH.—Sunny, 1, 2, 4, 5, 6, 7, 10, 16, 17, 23, 24, 25, 26, 27—14 days. Cloudy, 8, 9, 12, 13, 14, 15, 18, 20, 21, 22, 29, 30, 31—13 days. No record for the rest of the month.

APRIL.—Sunny, 3, 5, 7, 8, 15, 16, 17, 18, 19, 20, 21, 22, 23, 27, 28, 29—16 days. Cloudy, 1, 6, 11, 12, 25, 30—6 days. No record for the rest of the month.

MAY.—Sunny, 2, 3, 5, 7, 8, 12, 13, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31—21 days. Cloudy, 4, 9, 10, 15—4 days. No record for the rest of the month.

JUNE.—Sunny, 1, 3, 4, 6, 7, 8, 9, 10, 11, 12, 14, 15, 17, 18, 19, 20, 23, 24, 27, 28, 29, 30—22 days. Cloudy, 25—1, day. No record for the rest of the month.

JULY.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 16, 19, 20, 21, 22, 23, 30, 31—18 days. Cloudy, 9, 14, 26—3 days. No record for the rest of the month.

AUG.—Sunny, 2, 3, 6, 7, 8, 9, 10, 12, 13, 14, 15, 18, 19, 20, 25, 26, 27, 31—18 days. Cloudy, 5, 21, 22, 23, 24—5 days. No record for the rest of the month.

SEPT.—Sunny, 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 17, 18, 20, 25, 29—17 days. Cloudy, 9, 14, 22, 26, 27, 28, 30—7 days. No record for the rest of the month.

OCT.—Sunny, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 21, 22, 23, 24, 30, 31—17 days. Cloudy, 14, 17, 25, 26, 27, 28—6 days. No record for the rest of the month.

NOV.—Sunny, 1, 2, 3, 4, 14, 15, 16, 20, 21, 29—10 days. Cloudy, 6, 9, 10, 11, 12, 17, 18, 23, 24, 25, 26, 27, 30—13 days. No record for the rest of the month.

DEC.—Sunny, 5, 6, 7, 8, 9, 10—6 days. Cloudy, 1, 2, 4, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 26, 28, 29, 30—18 days. No record for the rest of the month.

SWARTZ CREEK.

JAN.—Sunny, 6, 13, 14, 21, 23, 24, 31—7 days. Fair, 11, 12—2 days. Cloudy, 1, 2, 3, 4, 5, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 28, 29, 30—22 days.

FEB.—Sunny, 2, 4, 8, 20, 23, 24, 26—7 days. Fair, 3, 9, 10, 11, 16, 27—6 days. Cloudy, 1, 5, 6, 7, 12, 13, 14, 15, 17, 18, 19, 21, 22, 25, 28—15 days.

MARCH.—Sunny, 1, 2, 4, 5, 6, 7, 10, 23, 24, 25, 26, 27—12 days. Fair, 3, 16, 18—3 days. Cloudy, 8, 9, 11, 12, 13, 14, 15, 17, 19, 20, 21, 22, 28, 29, 30, 31—16 days.

APRIL.—Sunny, 3, 4, 5, 7, 8, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 27, 28, 29—18 days. Fair, 2, 13—2 days. Cloudy, 1, 6, 9, 10, 11, 12, 24, 25, 26, 30—10 days.

MAY.—Sunny, 2, 3, 7, 8, 11, 12, 13, 16, 17, 19, 20, 21, 22, 23, 25, 28, 29, 30, 31—19 days. Fair, 4, 5, 6, 18, 27—5 days. Cloudy, 1, 9, 10, 14, 15, 24, 26—7 days.

JUNE.—Sunny, 3, 4, 6, 7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 26, 27, 28, 29, 30—21 days. Fair, 1, 2, 5, 10, 13, 22, 23—7 days. Cloudy, 24, 25—2 days.

DEC.—Sunny, 4, 5, 6, 7, 9, 10, 22—7 days. Fair, 15, 25—2 days. Cloudy, 1, 2, 3, 8, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 23, 24, 26, 27, 28, 29, 30, 31—22 days.

TABLE VII.—*Inches of Rain and Melted Snow for the Year and for each Month of the Year 1886, at 18 Stations in Michigan,—as compiled from Daily Observations made by Observers* for the State Board of Health, and for the U. S. Signal Service.*

Stations in Michigan.* (Those of the U. S. Signal Service in Italics.)	Divisions of the State.†	Inches of Rain and Melted Snow.												
		Year.		Months, 1886.										
		Norm. ‡	1886.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec
Av. for 18 Stations §	.....	.....	32.16	3.05	1.72	2.74	2.40	2.58	2.29	1.36	4.21	5.36	1.97	2.35	2.13
Marquette	U. P.	.....	29.28	3.14	1.18	2.19	2.15	1.17	3.79	1.33	3.70	1.94	2.15	3.75	2.79
Manistique and Gulliver Lake**	U. P.	15	39.62	4.55	3.81	3.52	4.45	1.40	4.38	2.69	1.64	3.25	5.43	2.68	1.82
Escanaba	U. P.	35.35 5	32.35	4.80	1.84	3.15	2.28	1.53	2.21	1.92	4.38	4.05	3.03	2.26	0.90
Traverse City	N. W.	42.49 8	42.65	5.49	2.51	4.60	2.48	2.49	0.97	0.85	4.20	7.61	4.45	3.84	3.16
Mackinaw City	N.	30.66 14	23.27	2.25	1.19	1.97	1.33	1.01	2.12	1.18	3.25	3.72	3.13	1.35	0 75
Alpena	N. E.	37.86	40.02	5.16	1.28	5.56	3.49	1.76	4.02	1.51	3.46	5.28	1.80	4.73	1.97
Harrisville	N. E.	11	35 80	4.35	2.15	3.66	3.22	1.20	5.01	2.07	4.33	3.09	1.57	2.88	2.27
Grand Haven	W.	40.45	35.31	2.62	3.50	3.04	2.84	1.99	2.31	0.90	6.57	4.81	2.50	2.56	1.67
Muskegon	W.	.....	33.46	3.15	0.57	4.17	2.49	2.02	1.44	0.45	7.61	4.00	2.44	2.11	3.01
Pentwater	W.	.....	35.25	3.36	3.00	4.24	1.99	0.77	0.44	0.49	4.58	6.65	3.58	2.91	3.24
East Saginaw	B. & E.	12	32.80	2.86	1.95	3.08	3.00	2.58	2.20	1.94	4.60	4.58	2.03	2.10	1.83
Port Huron	B. & E.	34.09 10	29.84	2.19	2.11	2.82	2.48	4.29	1.02	2.00	2.73	4.73	1.31	2.40	1.70
Thornville	B. & E	34.70 23	30.76	2.72	1.09	1.61	2 84	3.88	1.92	2.27	3.25	4.69	1.61	1.99	2.89
Agr'l College	C.	32.27 7	27.95	2.66	1.35	2.63	1.99	2.67	1.92	0.65	4.69	5.40	0.95	1.48	1.56
Lansing, S. B. of H.	C.	37.62 8	29.52	2.27	1.64	2.83	1.51	3.00	2.14	0.64	5.70	6.05	1.15	1.37	1.23
Swartz Creek	C.	32.59 2	27.07	2.61	0.87	3.77	2.08	3.00	2.24	0.71	2.31	4.30	1.25	1.98	1.95
Ann Arbor	S. C.	31.37	27.59	2.42	0.91	1.87	2.00	2.67	0.89	0.71	2.55	5.97	1.40	2.20	4 00
Hudson	S. C.	10	30.66	1.25	0.81	1.62	2.74	4.03	3.48	1.13	4 60	6.21	1.67	2.57	0.60
Kalamazoo	S. C.	39.35	32.09	3.80	1.64	1.64	1.17	3.64	2.98	2 16	4.77	5.63	1.29	1.33	2.02
Marshall	S. C.	2	32.73	1.98	1.92	2.98	1.85	3.64	3.37	1.02	3.68	6.91	1.00	1.88	2.50
Parkville	S. C.	47.09	40.18	3.93	1.72	1.87	3.79	3.04	3.32	1.31	7.11	8.11	1.38	1.33	3.27
Birmingham	S. E.	15	¶	2.10	1.30	2.35	1 90	2.97	1.82	.....	.....	.....	1.42	2.63	2.03
Detroit	S. E.	34.43	26.71	1.92	1.30	1.70	3.30	2.32	2.07	2.45	2.02	4.20	1.04	2.17	2.21

* The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit I, page 30.

† The names of divisions and the counties in each are stated in Exhibit I, in a paper which follows, on weekly reports of diseases.

‡ Numbers in this column state the average annual rainfall for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the rainfall, denote the number of years included in the average.

§ This line is an average for only the stations from which statements, nearly complete, are given for every month of the year. It does not include Manistique and Gulliver Lake, Harrisville, Swartz Creek, Muskegon or Birmingham.

¶ The total rainfall for 9 months in 1886 is 18.58 inches.

** The observations compiled in this line were made at Manistique until June 1. After that date they were made by the same observer with the same instrument at Gulliver Lake. Gulliver Lake is about 12 miles east from Manistique.

NOTE.—Computations of amount of rainfall were furnished by the observers at Escanaba and Mackinaw City, September excepted, Alpena, June excepted, Grand Haven, Port Huron, Ann Arbor, except for December, Marquette and Detroit for the year. All other computations in Table VII. were made in the offices of the Secretary of State and the State Board of Health.

The lines for 7 representative stations in Table VII. are graphically represented in Diagram VII., page 78.

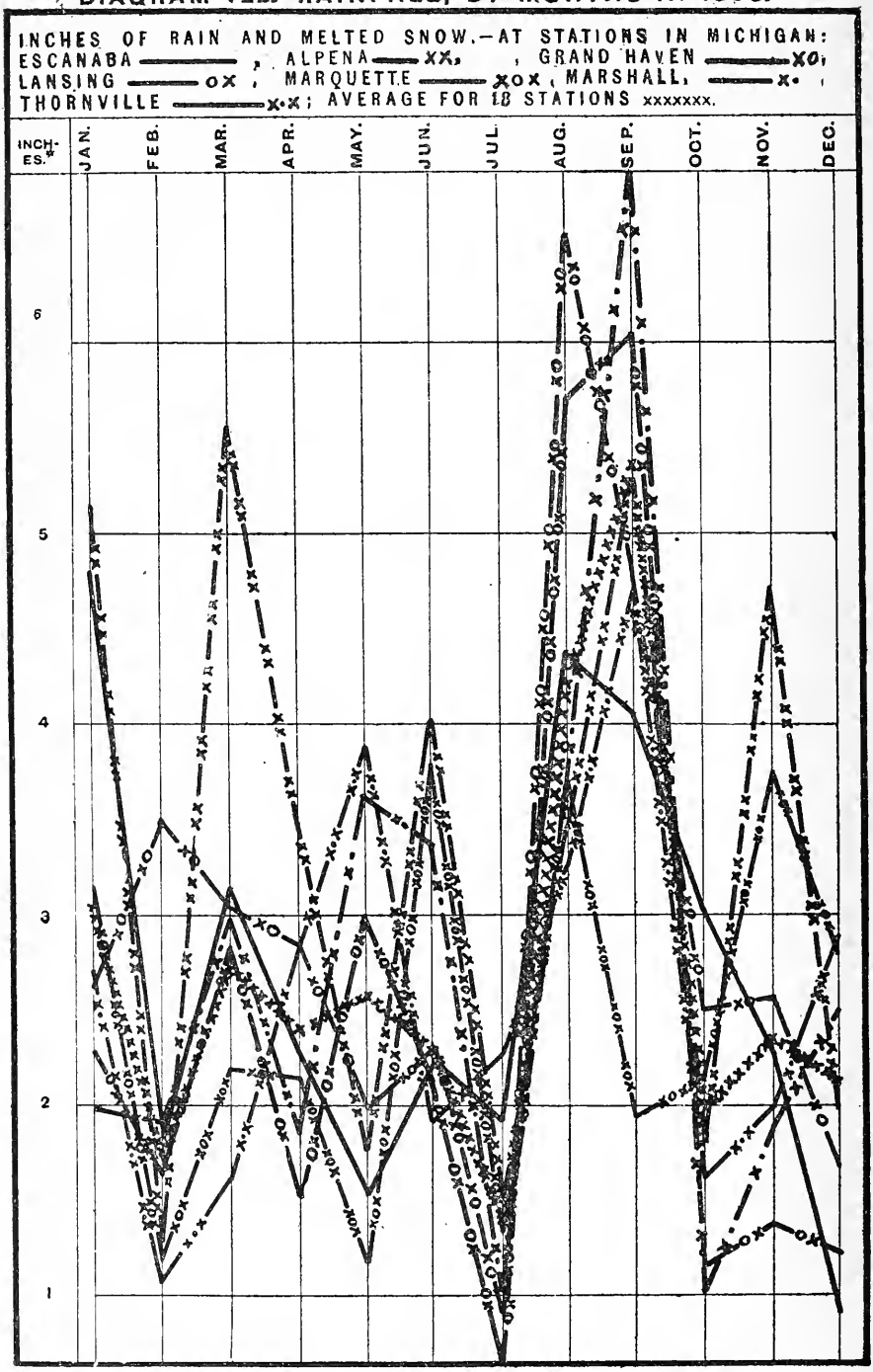
EXHIBIT 21.—*Dates of Solar and Lunar Halos,*

Line Number.	Stations.	Dates of Halos Recorded,									
		January.		February.		March.		April.		May.	
		Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.
1	Marquette	.....	14	.....	17	14,23,28	14,16	.....	.....	.....	9,14
2	Manistique	.....	.....	.....	.....	.....	.....	.....	11	5,7,8	.....
3	Escanaba	7,8,10	14,17	14,20	14,15	12,15	16	6	11,13	7,8	14,21
4		12,22,26	.....	24,28	17,18	22,28	.....	.....	14,16	.....	.....
5	Traverse City	.....	.....	27	.....	.....	.....	.....	.....	.....	.....
6	Mackinaw City	.....	.....	.....	10,14	24	12	.....	10	.....	9
7	Alpena	.....	14	.....	14	24	12,16	9	.....	.....	15
8	Grand Haven	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	Port Austin	.....	14	9,10,21,22	.....	.....	.....	.....	.....	.....	.....
10	Port Huron	2,8	.....	.....	.....	11,24	18	14	17	.....	.....
11	Thornville	.....	14	.....	.....	.....	17,18	.....	.....	.....	13
12	Lansing	12	12,14	10,27	12	.....	18	24	.....	14,21	13
13		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	Swartz Creek	.....	.....	9	9,10,11	17	17	8,13,14	13,17	.....	13
15		.....	.....	.....	18,19	.....	.....	.....	.....	.....	.....
16	Kalamazoo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	Birmingham	.....	.....	11	11	.....	11	.....	.....	13	14
18	Gulliver Lake	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	Hudson	.....	.....	.....	.....	.....	.....	29	.....	.....	.....

Recorded on the Monthly Registers in 1886.

Months, 1886.														
June.		July.		August.		September.		October.		November.		December.		Line Number.
Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.	
.....	.....	.....	.....	.....	.....	25	.....	2,7	.....	16	15	29	4,9	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
6	.....	8	.....	.....	.....	.....	8,21	.....	.....	25	15	17	8,9	3
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15	.....	.....	6
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19	5,15	.....	9	7
.....	6	11	.....	.....	.....	.....	.....	.....	.....	.....	4	18	.....	8
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
.....	.....	.....	.....	.....	.....	.....	.....	.....	11	.....	.....	.....	.....	11
.....	.....	.....	8	.....	.....	.....	.....	.....	11	12,16	11,15	10,11,20	5,8	12
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22,30	.....	13
.....	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,11	14
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	29	16
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30	10	17
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26	.....	.....	.....	18
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19

DIAGRAM VII.—RAINFALL, BY MONTHS IN 1886.



*SCALE, 1 IN. RAINFALL TO 1.02 IN. VERTICALLY.

H. B. T. DEL. DES. BY H. B. B.

EXHIBIT 22.—*Inches of Rain and Melted Snow by Years and Months, in 1886, compared with Annual and Monthly Average for 1885, and for the ten Years, 1877-86. These Averages are for Groups of Several Stations in Michigan.**

Years, etc.	Inches of Rain and Melted Snow.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 yrs., 1877-86 *.	37.18	2.13	2.54	2.53	2.65	3.41	4.22	3.61	3.58	3.57	3.62	3.23	2.76
1885 (17 stations*)	35.82	2.90	1.83	1.29	2.42	2.75	3.79	3.00	5.72	2.93	3.35	2.90	2.94
1886 (18 stations*)	32.16	3.05	1.72	2.74	2.40	2.58	2.29	1.36	4.21	5.36	1.97	2.35	2 13
In 1886 **Greater** than Av. for 10 yrs. 1877-86	.....	0.92	.....	0.21	.....	.....	.....	.....	0.63	1.79	.....	.....	.....
In 1886 **Less** than Av. for 10 yrs., 1877-86	5.02	.....	0.82	.....	0.25	0.83	1.93	2.25	.....	.....	1.65	0.88	0.63
In 1886 **Greater** than in 1885	.....	0.15	.....	1.45	.....	.....	.....	.....	.....	2.43	.....	.....	.....
In 1886 **Less** than in 1885	3.66	.....	0.11	.....	0.02	0.17	1.50	1.64	1.51	.....	1.38	0.55	0.81

* Thornville, Kalamazoo, Detroit, for 1877-86; Mendon for 1877-8 and 1880-2; Tecumseh for 1877-8 and 1880-5; Niles for 1878-81; Nirvana, Coldwater, Woodmere Cemetery (near Detroit) for 1877-9; Agricultural College for 1877-8 and 1881-6; Otisville for 1878-80, and 1882; Marquette for 1879-84 and 1886; Alpena, Grand Haven, Port Huron, 1879-86; Battle Creek for 1877-8 and 1884; Benton Harbor for 1877-8; Escanaba, Lansing for 1880-86; Washington for 1880-83; Fife Lake, Ypsilanti for 1877; Harrisville for1881-2; Reed City for 1881-5; Winfield for 1881-3; Ann Arbor for 1881-2 and 1885-6; Marshall for 1881-4 and 1886; Hudson and Mallory Lake for 1881 and 1886; Traverse City, for 1882-6; Hastings for 1882; Hillsdale for 1882-4; Parkville for 1882-3 and 1885-6; Ionia for 1883-4; Manistique and Swartz Creek for 1884-5; Mackinaw City for 1884-6; Pentwater, East Saginaw for 1886.

EXHIBIT 23.—*Comparison of the Rainfall during the Year and during each month of the Year 1886, with that for the Year 1885; and with the Average for the 22 Years, 1864-85. Observations made by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Michigan.*

Years, etc.	Inches of Rain and Melted Snow.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 22 yrs., 1864-85	32.47	1.75	1.98	2.59	2.50	3.13	4.37	3.59	2.81	2.92	2.69	2.26	1 92
1885	35.00	2.70	0.73	0.58	2.47	2.30	6.01	2.52	5.82	3.75	3.08	2.90	2.14
1886	27.95	2.66	1.35	2.63	1.99	2.67	1.92	0 65	4.69	5.40	0.95	1.48	1.56
In 1886 **Greater** than av. for 22 yrs. 1864-85	.....	0.91	.....	0.04	.....	.....	.....	.....	1.88	2.48	.....	.....	.....
In 1886 **Less** than av. for 22 yrs., 1864-85	4.52	.....	0.63	.....	0.51	0.46	2.45	2.94	.....	.....	1.74	0.78	0.36
In 1886 **Greater** than in 1885	.....	.....	0.62	2.05	.....	0.37	.....	.....	.....	1.65	.....	.....	.....
In 1886 **Less** than in 1885	7.05	0.04	.....	.....	0.48	.....	4.09	1.87	1.13	.....	2.13	1.42	0.58

OBSERVATIONS FOR OZONE AT LANSING.

Since July 1, 1884, the observations for ozone at Lansing have been taken at the new shelter for meteorological instruments in the southwest part of the Capitol yard. Previous to July 1, 1884, the observations had been taken at the office window. Exhibit E, page 60, of the report for 1885, shows that the average for the month of July, 1884, is greater at each observation—7 A. M. to 2 P. M., 2 P. M. to 9 P. M., and 9 P. M. to 7 A. M. at the shelter for instruments than at the office window. Possibly this fact should be taken into consideration in studying ozone at Lansing through a long period of ears.

EXHIBIT 24.—*Average Amount of Atmospheric Ozone (Day) by Year and Months, in 1886, compared with Annual and Monthly Average for 1885, and for the ten years 1877–1886. These Averages are for Groups of several Stations in Michigan.**

Years, Etc.	Ozone by Day.—Degree of Coloration of Test Paper.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 Yrs., 1877–86..	3.06	3.33	3.46	3.44	3.21	3.09	2.88	2.69	2.88	2.74	2.78	3.01	3.18
1885 (16 stations).....	2.92	2.88	3.05	3.31	3.21	2.96	2.61	2.47	3.07	2.72	3.03	2.87	2.92
1886 (10 stations).....	2.99	2.87	2.92	2.89	2.89	2.91	2.89	2.51	3.04	2.94	3.14	3.30	3.54
In 1886 **Greater** than av. for 10 yrs., 1877–86.....	.....	.....	.....	.....	.....	.....	0.01	.....	0.16	0.20	0.36	0.29	0.36
In 1886 **Less** than av. for 10 yrs. 1877–86.....	0.07	0.46	0.54	0 55	0.32	0.18	.....	0.18	.....	.....	.....	.....	.....
In 1886 **Greater** than in 1885.....	0.07	.....	.....	.....	.....	.....	0.28	0.04	.....	0.22	0.11	0.43	0.62
In 1886 **Less** than in 1885.....	.....	0.01	0.13	0.42	0.32	0.05	.....	.....	0.03	.....	.....	.....	.....

* Thornville, Kalamazoo for 1877–86; Mendon for 1877–83; Tecumseh for 1877–85; BattleCreek for 1877–80 and 1882–4; Niles for 1878–81; Nirvana for 1877–9; Coldwater, Agricultural College for 1877–9 and 1880; Otisville for 1878–80 and 1882; Alpena, Lansing for 1879–86; Washington for 1879–83; Petoskey and Woodmere Cemetery (near Detroit) for 1878–9; Marquette for 1880–81 and 1883–4, 1886; Grand Haven for 1880–4; Ann Arbor for 1880–6; Fife Lake, Ypsilanti for 1877; Ionia for 1880 and 1883–4; Adrian for 1880; Hudson and Mallory Lake for 1881; Escanaba Reed City, Port Huron for 1881–5; Harrisville for 1881–2 and 1885–6; Marshall, for 1881–6; Traverse City for 1882–6; Hastings, Parkville for 1882; Hillsdale for 1882–4; Port Austin for 1883–5; Winfield for 1883; Manistique, Mackinaw City, Swartz Creek for 1884–5; Pentwater for 1886.

EXHIBIT 25.—*Average Amount of Atmospheric Ozone (Night), by Year and Months in 1886, compared with Annual and Monthly Average for 1885 and for the ten Years, 1877–1886. These Averages are for Groups of several Stations in Michigan.**

Years, Etc.	Ozone by Night.—Degree of Coloration of Test Paper.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 yrs, 1878–86*..	3.23	3.91	4.04	4.07	3.56	3.31	2.98	2.55	2.49	2.54	2.99	3.35	3.55
1885 (16 stations*).....	3.47	3.49	3.65	3.75	3.96	3.68	3.20	3.00	3.41	3.14	3.43	3.38	3.50
1886 (10 stations*).....	3.46	3.89	3.90	3.63	3.26	3.27	3.28	2.88	3.28	3.45	3.53	3.59	3.60
In 1886 **Greater** than Av. for 10 yrs, 1877–86.....	0.23	.....	.....	.....	.....	.....	0.30	0.33	0.79	0.91	0.54	0.24	0.05
In 1886 **Less** than Av. for 10 yrs, 1877–86.....	.....	0.02	0.14	0.44	0.30	0.04	.....	.....	.....	.....	.....	.....	.....
In 1886 **Greater** than in 1885.....	.....	0.40	0.25	.....	.....	.....	0.08	.....	.....	0.31	0.10	0.21	0.10
In 1886 **Less** than in 1885.....	0.01	.....	.....	0.12	0.70	0.41	.....	0.12	0 13	.....	.....	.....	.....

*The stations represented in Exhibit 25 are the same as those represented in Exhibit 24, relative to day ozone, and named in foot-note of that Exhibit.

DIAGRAMS RELATING TO METEOROLOGICAL CONDITIONS.

Most of the diagrams in this paper are to be read by tracing each irregular line across the diagram from left to right, and noting at what point it intersects each of the perpendicular lines having the name of the month at the top. What station is represented by the irregular line may be learned from the head of the diagram. The degree of value denoted by the intersection may be learned by referring to the figures in the left-hand column. Thus, in Diagram I., page 46, relating to average temperature in 1886, tracing the line "—o" representing Harrisville, it may be seen that the average temperature at Harrisville was, in January, about 18°, in February, 19°, in April about 41°, in July about 67°, in October about 50°, etc. Definite numerical statements of the average temperature for each month at each station may be found in Table I., page 47, and accompanying each diagram is a table giving exact numerical statements for the conditions represented. The average line given in each table is the corresponding diagram represented by an × line, thus ××× ×××. The lines in the diagrams give more ready general comparisons of stations with each other, or of months with each other, than is possible from the mere numerical statements. By Diagram II., page 51, it appears at a glance that the average daily range of temperature at Marshall in 1886, was, during July, higher than at any other of the eight stations represented in that diagram, and during January and November was considerably lower at Thornville. The marked agreement in the course of the lines in Diagram I., page 46, representing mean monthly temperature at six stations, and also that the agreement is closer in the last three months of the year than in earlier months, appear at once on reference to the diagram. The resemblance between the lines in Diagram I., page 46, relating to mean temperature by months in 1886, and those in Diagram III, page 55, relating to absolute humidity of the atmosphere for the same periods, is apparent. By Diagram X., page 87, it appears that in every month of the year the highest velocity of the wind (on an average for the month) is reached between 1 P. M. and 3 P. M., and that the lowest velocity occurs in the latter part of the night or in early morning, and that in 1886, at Lansing, the months of most wind were February and November. By reference to Diagram XI., page 89, it may be seen that at other stations in Michigan where records of actual miles of wind traveled were kept, February and November were, in 1886, the months of greatest wind. These statements illustrate the reading of the diagrams for any use it may be desired to make of the tables and diagrams. The three diagrams relating to direction of the wind are constructed on a different principle and the manner of reading them is explained on page 92 of this article.

TABLE VIII.—*Relative Amount of Ozone in the Atmosphere, by Day, during the Year and during each month of the Year 1886, at 10 Stations in Michigan,—as indicated by Averages of Observations made Daily by exposing Test-paper prepared according to Schönbein's formula, from 7 A. M. to 2 P. M.—Recorded according a to scale of 10 Degrees of Coloration of the Test-paper (greatest coloration by ozone equals 10) by observers for the State Board of Health, and for the U. S. Signal Service.**

Stations in Michigan.† (Those of U. S. Signal Service in Italics.)	Divisions of the State.†	Degrees of Coloration of Test-paper—Day Observations. Year. Norm.‡	1886.	Months, 1886. Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec
Av. for 10 Stations.§	.....	.....	2.99	2.87	2.92	2.89	2.89	2.91	2.89	2.51	3.04	2.94	3.14	3.30	3.54
Marquette	U. P.	.....	3.44	d 0.52	f 1.28	0.94	c 2.32	2.87	3.77	4.32	3.94	5.37	4.35	5.17	6.48
Escanaba	U. P.	 5	¶	2.82	2.70	2.90	2.97	1.80	2.50	2.00	3.00	3.33	2.87	3.34	.....
Traverse City	N. W.	2.66	2.72	3.45	3.57	3.68	2.77	2.77	2.27	1.87	2.26	1.63	2.35	2.90	3.06
Mackinaw City	N.	 8	‖	4.19	3.60	3.50	2.90	2.50	.....	2.40	2.60	2.40	2.39	.....	2.50
Alpena	N. E.	3.31 2	3.20	3.61	3.61	3.16	3.27	2.65	2.47	2.26	3.42	3.07	2.77	3.57	4.55
Harrisville	N. E.	4.44	4.52	5.03	5.04	4.87	4.37	4.03	4.57	4.32	4.45	4.50	4.74	3.93	4.35
Grand Haven	W.	.....	**	3.26	2.00	2.30	1.98	2.60	2.30	2.30	.....	2.70	3.58	3.40	2.30
Pentwater	W.	.....	2.52	a 2.45	2.54	2.90	h 2.37	2.19	1.83	a 1.97	2.65	2.80	2.58	2.80	b 3.14
Reed City	W.	.....	††	3.07	2.86	3.13	3.30	2 42	1.97	3.00	.....	.....	.....	.....	.....
East Saginaw	B. & E.	.....	‡‡	b 2.90	f 3.64	b 3.34	b 4.38	j 4.52	.....	e 3.65	g 3.33	e 3.35	c 3.75	c 3.64	3.19
Port Austin	B. & E.	.....	§§	a 2.47	3.04	2.52	2.23	a 1.87	c 1.93	2.42	e 1.92	1.97	2.13	.....	.....
Port Huron	B. & E.	 10	¶¶	2.10	1.90	1.60	1.33	1.30	1.50	1.70	.....	1.30	1.13	1.83	2.39
Thornville	B. & E.	2.66	2.41	3.26	3.11	2.94	1.87	1.84	1.80	1.42	2.13	1.90	2.52	2.90	3.26
Ionia	C.	 8	‖‖	j 2.14	0.87	i 2.14	1.67	.....	.....	2.16	3.03	2.43	2.10	2.03	1.90
Lansing, S. B. of H.	C.	3.27 2	3.11	2.29	1.96	1.71	3.33	4.06	3.97	1.29	4.23	3.70	3.58	3.97	3.26
Swartz Creek	C.	2.99 7	2.78	a 3.19	3.57	a 3.27	c 2.84	a 2.80	b 2.52	2.60	2.76	2.20	2.76	2.09	a 2.73
Ann Arbor	S. C.	2.59	2.92	3.19	d 2.70	a 3.20	b 2.86	a 2.71	2.67	a 2.67	f 2.44	b 2.27	3.91	c 3.35	3.10
Battle Creek	S. C.	 10	A	c 1.61	1.30	.....	1.48	a 1.53	1.40	1.35	1.65	.....	a 1.08	b 1.09	b 1.12
Kalamazoo	S. C.	2.65 6	2.23	2.23	2.32	2.48	2.50	2.48	2.03	2.19	2.39	1.53	2.29	2.10	2.36
Marshall	S. C.	3.64	2.80	2.68	3.11	3.06	3.27	3.52	3.53	2.81	2.45	2.60	2.26	2.33	1.97
Birmingham	S. E.	.....	B	a 2.93	j 3.10	a 3.23	b 3.24	3.65	2.20	.....	.....	.....	.....	.....	2.42

* At the stations of the U. S. Signal Service the observations were made by exposing the test paper from 7 A. M., to 3 P. M., 75th Meridian time. The corresponding local time for each of these stations is stated in the (*) foot-note to Table I., page 47.

† The names of observers, their places of observation, and the counties in which these places are situated are stated in Exhibit 1, page 30. The full names of the divisions and the counties in each division are stated in Exhibit I, in a paper which follows, on weekly reports of sickness.

‡ Numbers in this column state the average annual relative amount of ozone by day for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the average denote the number of years included in the average.

§ This line is an average for only the stations from which statements, nearly complete, were received for every month in the year. It does not include Escanaba, Mackinaw City, Reed City, East Saginaw, Port Austin, Port Huron, Swartz Creek, Grand Haven, Battle Creek, Birmingham or Ionia.

¶ The average for 11 months in 1886 is 2.75. ‖ For 10 months, 2.90. ** For 11 months, 2.61. †† For 7 months, 2.82. ‡‡ For 11 months, 3.61. §§ For 10 months, 2.25. ¶¶ For 11 months, 1.64. ‖‖ For 10 months, 2.05. A. For 10 months, 1.36. B. For 7 months, 2.97.

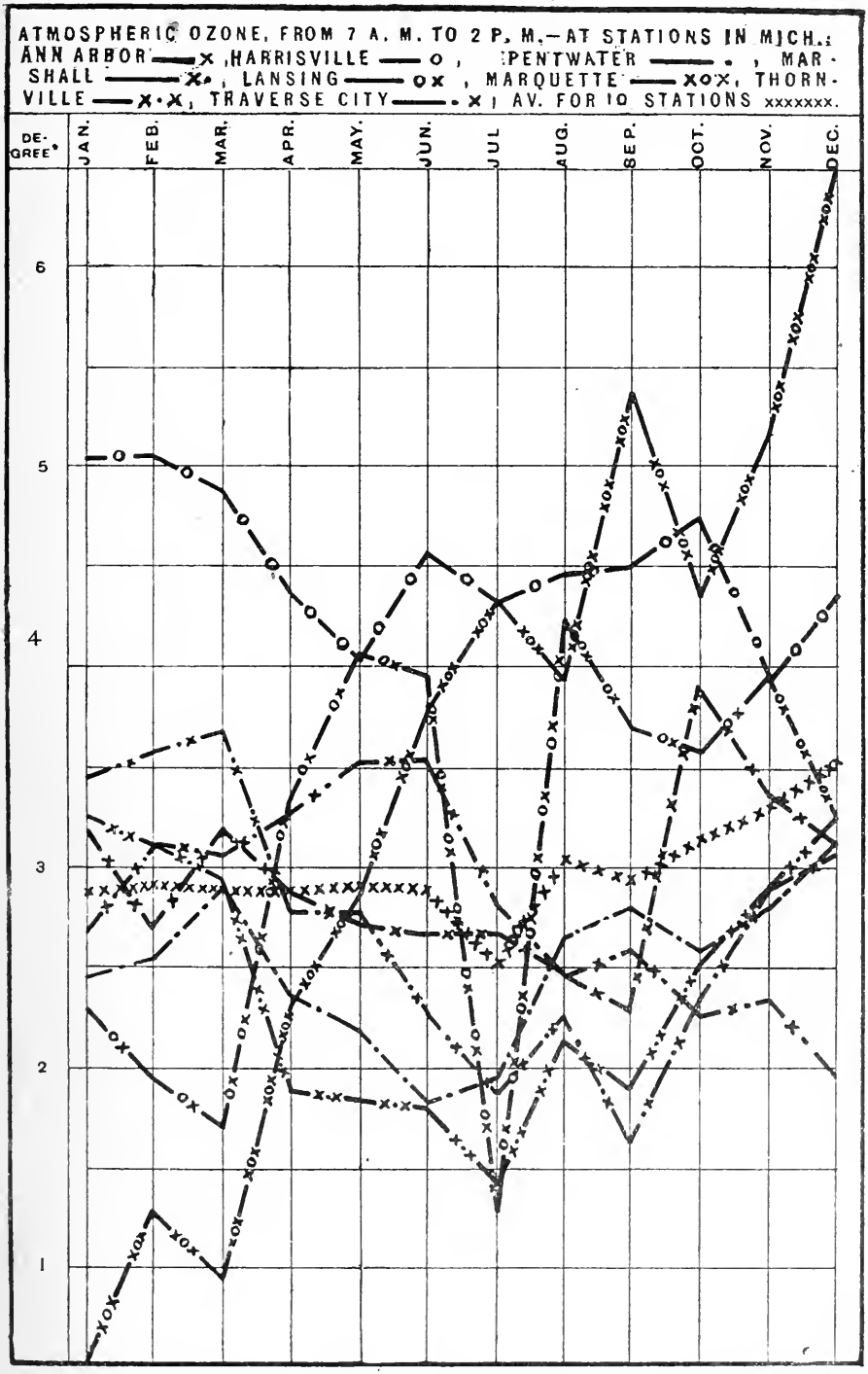
a, b, c, In the columns from January to December, inclusive, the letters a, b, c, etc., stand directly above the numbers from which they refer to the notes below.

a For 30 days. b For 29 days. c For 28 day. d For 27 days. e For 26 days. f For 25 days. g For 24 days. h For 23 days. i For 22 days. j For 21 days.

NOTE.—The computations were furnished by the observers at Ann Arbor for the year; at Mackinaw City for Jan. to May, July to Oct., and Dec.; at Escanaba, Jan. to May, and Aug.; at Grand Haven, Jan. to July, and Sept. to Dec.; at Port Huron for Jan. to July and Sept., for July, Oct. and Nov. All other computations for Table VIII were made in the office of the State Board of Health.

Eight lines in this table are graphically represented in Diagram VIII., page 83.

DIAGRAM VIII.—OZONE, AV. BY DAY, MONTHS IN 1886.



SCALE, 1 DEG. OF COLORATION (ON SCALE OF 10 DEGS.) TO 1.07 IN. VERTICALLY.

H. B. T. del

DES. BY H. B. B.

TABLE IX.—*Relative amount of Ozone in the Atmosphere at Night, during the Year, and during each Month of the Year 1886, at 10 Stations in Michigan,—as indicated by Averages of Observations made Nightly by Exposing Test-paper, prepared according to Schönbein's formula, from 9. P. M. to 7 A. M.,—Recorded according to a Scale of 10 Degrees of Coloration of the Test-paper (greatest coloration by Ozone equals 10), by Observers for the State Board of Health, and for the U. S. Signal Service.**

Stations in Michigan.† (Those of the U. S. Signal Service in Italics.)	Divisions of the State.†	Degrees of Coloration of Test-paper.—Night Observations.													
		Year.		Months, 1886.											
		Norm.‡	1886.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 10 stations§	.....	.....	3.46	3.89	3.90	3.63	3.26	3.27	3.28	2.88	3.28	3.45	3.53	3.59	3.60
Marquette	U. P.	.....	3.26	4.19	4.81 d	2.50 a	1.43	1.90	2.30	3.61	4.32	3.63	3.45	3.20	3.74
Escanaba	U. P.	 5	¶	3.06	3.30	3.10	3.40	2.60	2.70	2.20	3.00	3.07	3.58	3.80	.....
Traverse City	N. W.	2.77	2.76	3.97	3.57	3.94	3.03	2.77	2.07	1.16	1.77	1.90	2.45	3.07	3.39
Mackinaw City	N.	 8	||	5.29	3.80	3.60	2.83	2.60	.....	2.40	2.60	2.60	2.61	.....	2.70
Alpena	N. E.	3.86 2	4.87	4.58	5.00	4.77	4.83	4.13	4.60	4.13	5.55	4.93	4.97	5.37	5.55
Harrisville	N. E.	5.46	5.90	6.52	6.18	5.03	5.20	5.29	6.57	6.16	5.71	6.07	6.42	5.93	5.77
Grand Haven	W.	.....	††	2.60	2.50	1.80	2.02	2.70	2.60	2.10	.....	2.70	3.45	3.40	2.22 a
Pentwater	W.	.....	3.16	4.00 a	3.75	4.13	2.97 g	2.61	2.43 b	1.71 a	2.87	2.70	3.06	3.70	3.97
Reed City	W.	.....	**	3.80 b	4.14 d	4.03 b	4.00 e	2.97 a	2.24	3.33 f	b	d	.....	b	.....
East Saginaw	B. & E.	.....	‡‡	2.34	2.85	2.86	1.92	2.90 b	.....	1.72 a	1.74 e	2.89 b	2.61	1.69	1.48
Port Austin	B. & E.	.....	§§	3.68	3.39	4.23	4.27	2.79	3.37	3.07	3.23	3.48	3.16	.....	.....
Port Huron	B. & E.	 10	¶¶	2.90	2.70	2.50	2.00	1.90	2.00	2.10	.....	1.70	1.55	2.37	2.97
Thornville	B. & E.	3.25	3.08	4.19 h	3.79	3.68 d	2.70	3.03	2.50	2.06	2.42	2.63	3.23	3.20	3.55
Ionia	C.	 8	||||	2.57	1.61	2.37	2.90	.....	.....	1.74	2.10	0.97	0.97	0.87	0.90
Lansing	C.	3.77 3	3.74	2.71 a	2.29 d	2.16 a	3.70	4.29	4.73	3.77	4.42	5.70	4.16	3.93	3.06
Swartz Creek	C.	3.61 7	3.22	3.65	4.11 d	4.43	3.48	3.50	3.18	2.32 a	2.71 d	3.05	3.06	2.12	3.03 a
Ann Arbor	S. C.	2.61	2.87	3.42 c	3.40	3.60	3.20	2.87	2.67	2.00	1.93	2.27	3.55 a	3.37	2.17 a
Battle Creek	S. C.	 10	A	2.07	1.63	.....	1.50	1.65	0.60	0.53	0.53	.....	0.47	0.92	1.10
Kalamazoo	S. C.	3.02 6	2.38	2.81	3.25	3.16	2.40	2.84	2.20	1.26	1.16	2.00	1.94	2.47	3.03
Marshall	S. C.	3.12	2.62	2.48	3.00 i	3.32 a	3.10	2.97	2.73	2.94	2.68	2.70	2.03	1.70	1.77
Birmingham	S. E.	.....	B	3.23	4.10	3.97	3.80	4.32	2.57	.....	.....	.....	.....	.....	2.65

* At the U. S. Signal Service Stations for the year 1886, the observations were made by exposing the test-paper from 11 P. M. to 7. A. M., 75th Meridian time. The corresponding local time for each of these stations is stated in star (*) footnote to Table I., page 47.

† The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit I, page 30. The full names of divisions and the counties in each division are stated in Exhibit I, in a paper which follows on weekly reports of sickness.

‡ Numbers in this column state the average annual relative amount of ozone by night for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the average, denote the number of years included in the average.

§ This line is an average for only the stations from which statements, nearly complete, were received for every month in the year. It does not include Escanaba, Mackinaw City, Reed City, East Saginaw, Port Austin, Port Huron, Swartz Creek, Grand Haven, Ionia, Battle Creek, or Birmingham.

¶ The average for 11 months is 3.07. || For 10 months, 3.10. †† For 11 months, 2.55. ** For 7 months, 3.50. ‡‡ For 11 months, 2 27. §§ For 10 months, 3.47. ¶¶ For 11 months, 2.24. |||| For 10 months, 1.70. A For 10 months, 1.10. B For 7 months, 3.52.

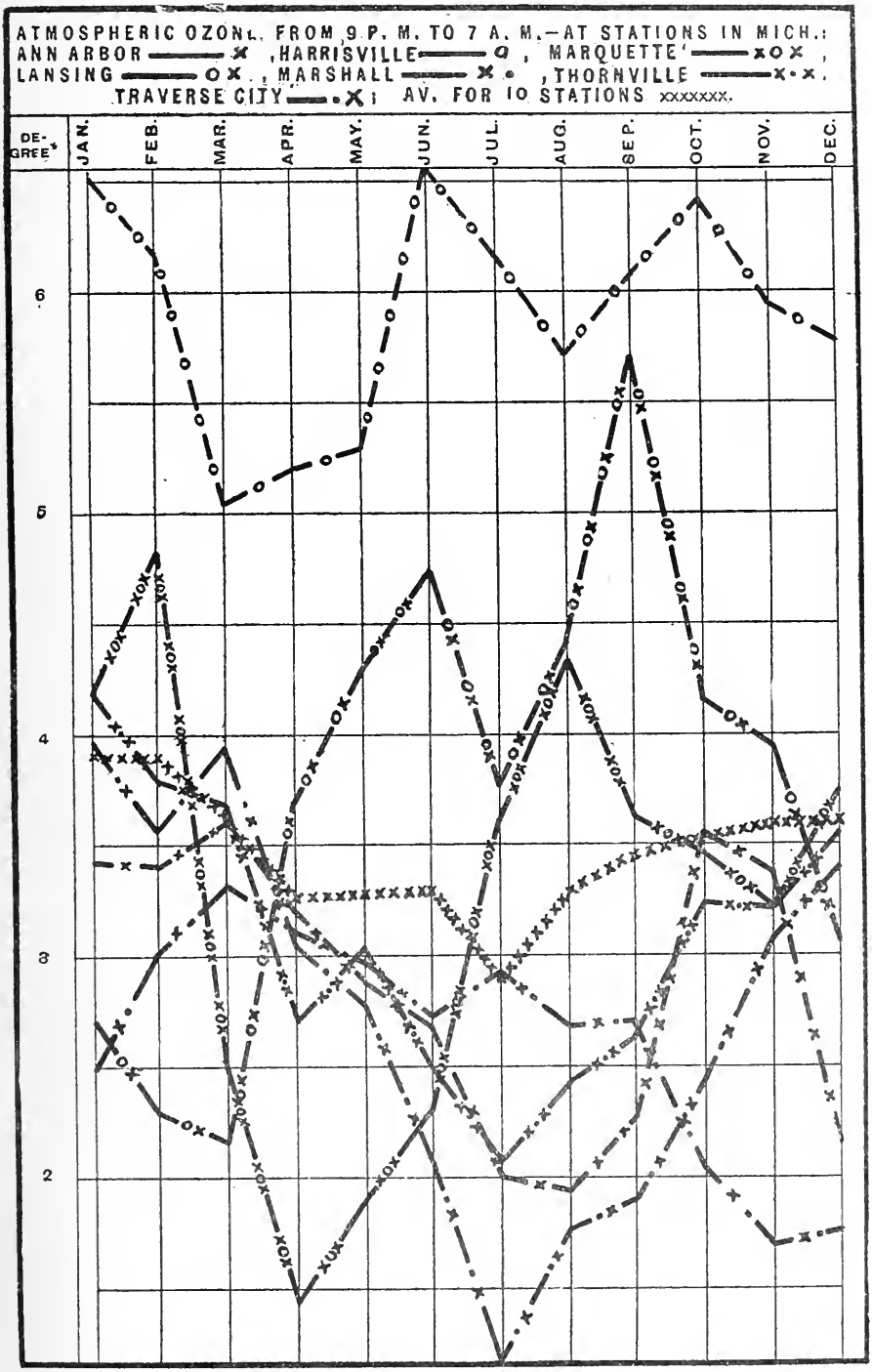
a, b, c, In the columns from January to December, inclusive, the letters a, b, c, etc., stand directly above the numbers from which they refer to the notes below.

a For 30 days. b For 29 days. c For 28 days. d For 27 days. e For 26 days. f For 25 days. g For 24 days. h For 23 days. i For 21 days.

NOTE.—The computations were furnished by the observers at Ann Arbor for the year, August excepted; at Mackinaw City, Jan. to May, and July to Oct., and Dec.; at Escanaba, Jan. to May, and July and Aug., Oct and Nov.; at Grand Haven, Jan. to July, and Sept. to Dec.; at Port Huron, Jan. to July, and Sept. All other computations in Table IX. were made at the office of the State Board of Health.

Seven lines in this table are graphically represented in Diagram IX., page 85.

DIAGRAM IX.—OZONE, AV. BY NIGHT, MONTHS IN 1886.



SCALE, 1 DEG. OF COLORATION (ON SCALE OF 10 DEGS.) TO 1.18 IN. VERTICALLY.

H. B. T., DEL. DES. BY H. B. B.

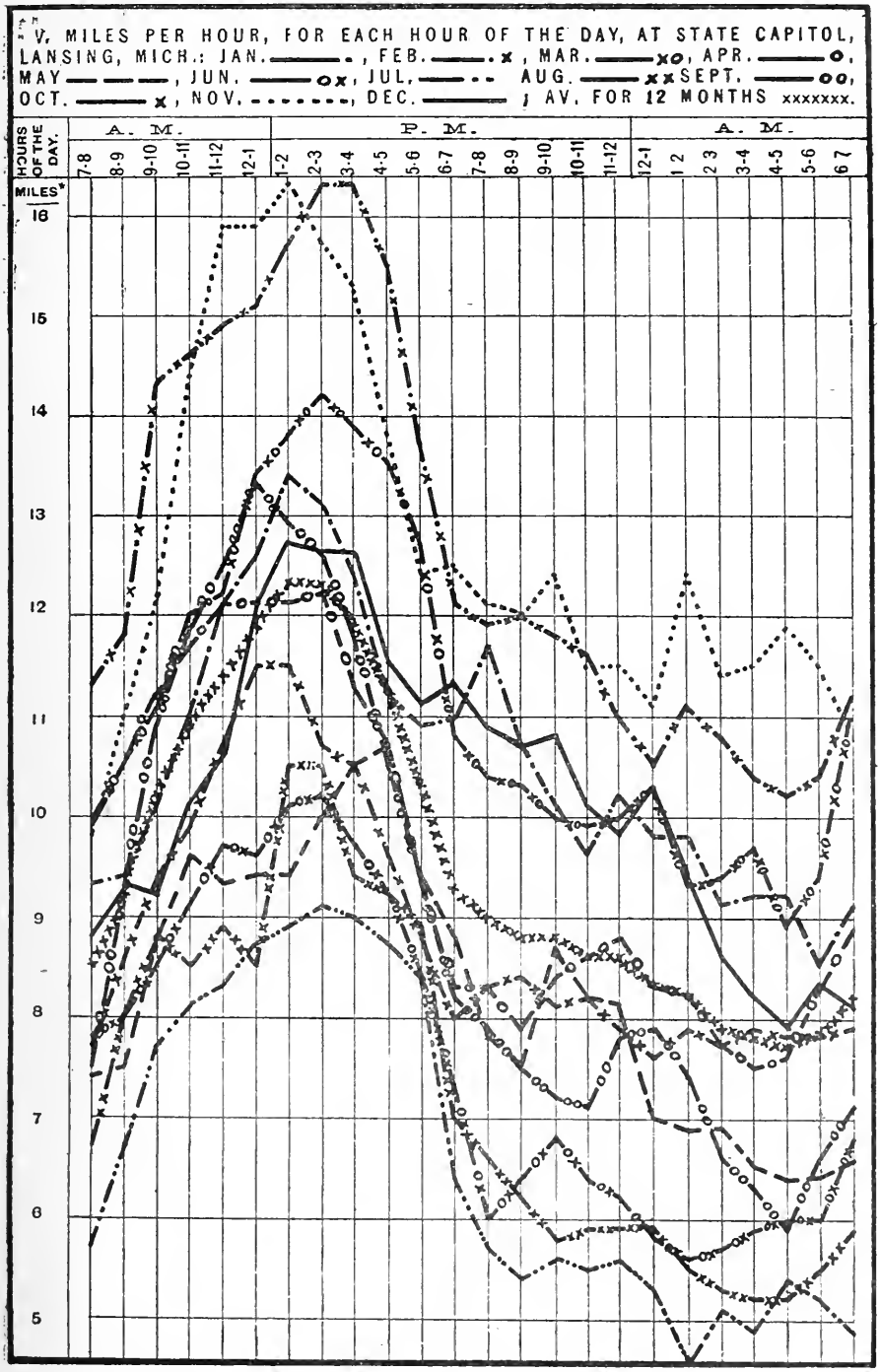
TABLE X.—*Average velocity of the Wind, in Miles per Hour for each Hour of the Day, by Months of the Year 1886. Compiled from Registers of the Robinson's Self-Registering Anemometer, exposed above the roof of the Capitol, and registering in the office of the State Board of Health, Lansing, Michigan.*

Months.	Average.			Hours (1886) and Average Miles Per Hour.																						
				A. M.					P. M.												A. M.						
	Av. 7 years, 1880-86.	1885.	1886.	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7
Year	9.9	9.5	9.5	8.5	9.2	10.2	10.9	11.4	11.9	12.3	12.3	11.9	11.2	10.3	9.3	9.0	8.8	8.8	8.6	8.6	8.3	8.2	7.9	7.8	7.7	7.8	8.2
January	11.3	13.6	10 6	9.3	9.4	10.1	11.0	12.1	12.6	13.4	13.1	12.4	11.2	10.9	11.0	11.7	10.7	10.1	9.6	10.2	9.8	9.8	9.1	9.2	9.2	8.5	9.1
February	11.6	10.8	12.7	11.3	11.8	14.3	14.6	14.9	15.1	15.7	16.3	16.3	15.5	13.7	12.1	11.9	12.0	11.8	11.6	11.0	10.5	11.1	10.8	10.4	10.2	10.4	11.2
March	11.4	11.9	11.1	10.0	10.5	11.1	12.0	12.2	13.4	13.8	14.2	13.9	13.5	12.7	10.8	10.4	10.3	10.0	9.9	10.0	10.3	9.3	9.4	9.7	8.9	9.4	11.0
April	11.3	10.5	9.6	9.9	10.5	11.2	11.7	12.1	12.1	12.1	12.2	11.3	10.7	9.3	8.3	8.3	7.9	8.4	8.6	8.8	8.3	8.2	7.7	7.5	7.6	8.3	8.9
May	9.9	9.0	8.2	7.4	7.5	8.8	9.6	9.3	9.4	9.4	10.0	10.5	10.7	9.4	8.8	7.8	7.5	8.7	8.2	8.1	7.0	6.9	6.9	6.5	6.4	6.4	6.6
June	8.7	8.9	7.5	7.8	8.0	8.5	9.1	9.7	9.6	10.1	10.2	9.7	9.2	8.4	7.3	6.0	6.4	6.8	6.4	6.2	5.8	5.6	5.7	5.9	6.0	6.0	6.8
July*	8.4	8.6	6.6	5.7	6.7	7.7	8.1	8.3	8.7	8.9	9.1	9.0	8.7	8.4	6.4	5.7	5.4	5.6	5.5	5.6	5.3	4.6	5.1	4.9	5.4	5.2	4.9
August	7.5	8.3	7.2	6.7	8.0	8.8	8.5	8.9	8.5	10.5	10.5	9.4	9.2	8.9	7.0	6.6	6.2	5.8	5.9	5.9	5.9	5.5	5.3	5.2	5.2	5.5	5.9
September	8.6	7.6	8.9	7.5	9.3	10.9	11.9	12.5	13.3	12.9	12.6	11.8	10.5	9.4	8.2	7.9	7.5	7.2	7.1	7.8	7.9	7.4	6.6	6.3	5.9	6.6	7.1
October	8.4	5.1	8.8	7.7	8.6	9.4	9.9	10.7	11.5	11.5	10.7	10.5	9.6	8.8	8.0	8.3	8.4	8.1	8.2	7.9	7.6	7.9	7.7	7.9	7.8	7.8	7.9
November†	11.1	7.7	12.7	9.8	11.0	12.2	14.4	15.9	15.9	16.3	15.7	15.3	13.8	12 4	12.5	12.1	12.0	12.4	11.5	11.5	11.1	12.4	11.4	11.5	11.9	11.5	10.8
December	11.1	12.4	10.2	8.8	9.3	9.2	10.1	10.6	12.1	12.7	12.6	12.6	11.5	11.1	11.3	10.9	10.7	10.8	10.1	9.8	10.3	9.4	8.6	8.2	7.9	8.3	8.1

* For only about 30 days. † For only about 28 days.

The statements in the third figure-column in Table X. of the average velocity of the wind in miles per hour, by months, during the year 1886, are graphically represented in Diagram XI., page 89. The remaining columns of Table X. for 1886 are graphically represented in Diagram X., page 87.

DIAGRAM X.—VELOCITY OF WIND, BY HOURS AND MONTHS, 1886.



*SCALE ONE MILE PER HOUR TO .54 IN. VERTICALLY.

H. B. T., DEL. DES. BY H. B. B.

EXHIBIT 28.—*Average Velocity of of the Wind in Miles per hour by Year and Months in 1886, Compared with Annual and Monthly Averages for 1885, and for the 5 years 1882-6. From Registers of the Robinson's Self-Registering Anemometer.* These Averages are for Groups of Several Stations in Michigan.*

Years, Etc.	Average Miles per Hour.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 5 Yrs., 1882-86*...	9.5	11.2	10.4	10.2	10.0	9.5	8.1	7.9	7.6	8.5	9.1	10.7	10.7
1885 (8 stations*).....	9.4	11.8	9.0	10.2	10.4	9.0	8.7	7.6	8.1	8.8	8.2	9.9	11.5
1886 (9 stations*).....	9.2	10.5	11.2	10.1	8.7	8.4	7.3	7.0	7.4	9.0	8.8	12.0	10.3
In 1886 **Greater** than Av. for 5 yrs., 1882-86.....	.....	.....	0.8	.....	.....	.....	.....	.....	.....	0.5	.....	1.3	.....
In 1886 **Less** than Av. for 5 yrs., 1882-86.....	0.3	0.7	.....	0.1	1.3	1.1	0.8	0.9	0.2	.....	0.3	.....	0.4
In 1886 **Greater** than in 1885.....	.....	.....	2 2	.....	.....	.....	.....	.....	.....	0.2	0.6	2.1	.....
In 1886 **Less** than in 1885.....	0.2	1.3	.....	0.1	1.7	0.6	1.4	0.6	0.7	.....	.....	.....	1.2

* Gibbon's Anemometer was used at Ann Arbor.

TABLE XI.—*Average Velocity of the Wind in Miles per Hour for the Year and for each Month of the Year 1886, at 9 Stations in Michigan. Computed from Registers of the Robinson's Self-registering Anemometer,* by Observers for the State Board of Health, and for the U. S. Signal Service.*

Stations in Michigan.†	Divisions of the State.	Miles, by Self-Registering Anemometer.												
		Year.		Months in 1886.										
		Norm.‡	1886.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug	Sept.	Oct.	Nov.	Dec.
Av. for 9 Stations....	.....	.....	9.2	10.5	11.2	10.1	8.7	8.4	7.3	7.0	7.4	9.0	8.8	12.0	10.3
Marquette.....	U. P.	.....	9.3	11.2	11.0	8.5	6.9	8.2	7.1	7.3	8.0	9.9	10.4	11.6	11.8
Escanaba	U. P.	8.7 (5)	8.0	9.6	9.7	9.0	6.5	7.4	6.8	6.9	7.2	7.4	8.1	9.3	8.2
Mackinaw City.....	N.	9.6 (3)	9.8	11.0	10.5	10.9	7.9	8.9	7.0	7.3	7.6	10.4	8.7	14.2	13.1
Alpena.....	N. E.	9.3 (5)	8.8	10.3	10.1	9.9	7.2	9.0	7.9	6.8	7.5	9.1	8.5	10.5	9.2
Grand Haven.....	W.	11.0 (5)	10.5	11.2	10.8	10.0	10.9	10.2	8.1	7.8	8.3	11.5	11.3	14.7	11.6
Port Huron.....	B. & E.	9.2 (7)	9.5	9.8	12.3	10.6	9.5	8.2	7.4	6.9	7.3	8.0	8.6	14.2	11.2
Lansing, S. B. of H...	C.	9.9 (5)	9.5	10.6	12.6	11.1	9.6	8.2	7.5	6.6	7.2	8.9	8.8	12.6	10.3
Ann Arbor.....	S. C.	9.1 (5)	8.5	10.2	11.8	10.4	8.9	7.1	6.1	6.0	5.9	7.0	7.5	12.1	8.8
Detroit.....	S. E.	9.5	8.9	10.2	12.2	10 3	10.5	8.2	7.8	7.5	7.6	8.4	6.9	9.2	8.4

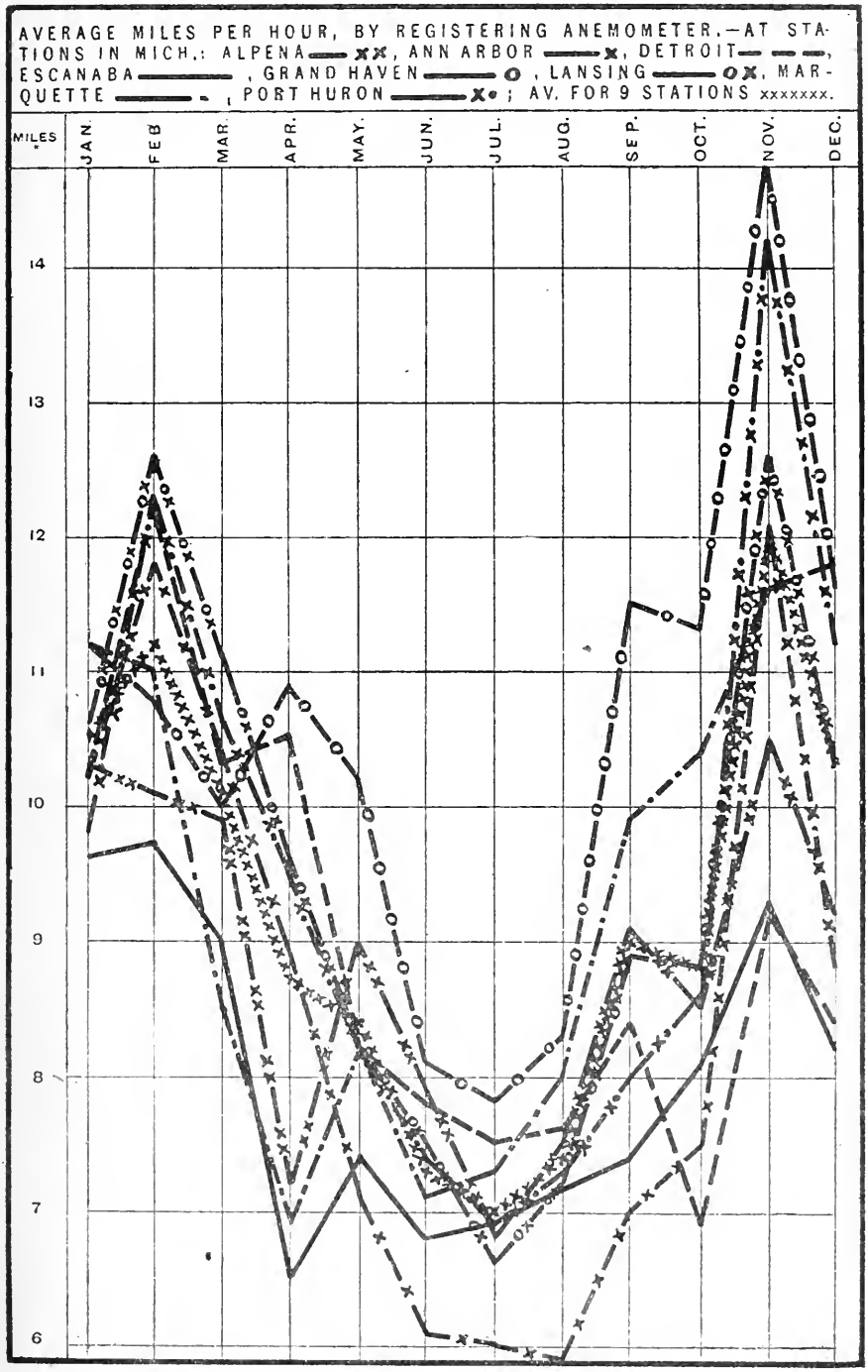
* Gibbon's Anemometer was used at Ann Arbor.

† The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit 1, page 30.

‡ Numbers in this column state the average velocity of the wind in miles per hour for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the average denote the number of years included in the average.

Graphic representations of statements made in Table XI. are given in Diagram XI., page 89.

DIAGRAM XI.—VELOCITY OF WIND, BY MOS., IN 1886.



*SCALE, ONE MILE PER HOUR TO .72 IN. VERTICALLY.

H. B. T., DEL. DES. BY H. B. B.

EXHIBIT 26.—*Average Velocity of the Wind in Miles per Hour, by Months, for the 7 Years, 1880–86, and comparisons of 1886 with this average and with the Year 1885. From Registers of the Robinson's Self-Registering Anemometer in the office of the State Board of Health, State Capitol, Lansing, Michigan.*

Years, etc.	Miles, by Self-Registering Anemometer.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 7 yrs. 1880-86	9.9	11.3	11.6	11.4	11.3	9.9	8.7	8.4	7.5	8.6	8.4	11.1	11.1
1885	9.5	13.6	10.8	11.9	10.5	9.0	8.9	8.6	8.3	7.6	5.1	7.7	12.4
1886	9.5	10.6	12.6	11.1	9.6	8.2	7.5	6.6	7.2	8.9	8.8	12 6	10.3
In 1886 **Greater** than av. for 7 yrs., 1880-86	.....	.....	1.0	.....	.....	.....	.....	.....	.....	0.3	0.4	1.5	.....
In 1886 **Less** than av. for 7 yrs., 1880-86	0.4	0.7	.....	0.3	1.7	1.7	1.2	1.8	0.3	.....	.....	.....	0.8
In 1886 **Greater** than in 1885	0	.....	1.8	.....	.....	.....	.....	.....	.....	1.3	3.7	4.9	.....
In 1886 **Less** than in 1885	0	3.0	.....	0.8	0.9	0.8	1.4	2.0	1.1	.....	.....	.....	2.1

EXHIBIT 27—DIRECTION OF WIND, 1878–86.—*Number of Observations per Month (at 7 A. M., 2 P. M. and 9 P. M.* Daily), at which the Wind was Blowing from the several (eight) Points of Compass. Annual and Monthly Averages for the 9 Years 1878–86, at Stations in Michigan.*†

Points of Compass.	Average Number of Observations per Month,—9 Years, 1878-86.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
All observations	91	93	85	93	90	93	90	93	93	90	92	90	93
Calm	5	4	4	4	4	5	5	7	8	6	5	4	4
North	7	6	6	9	9	8	8	8	8	5	7	5	5
Northeast	8	6	7	9	12	12	9	8	10	7	8	5	5
East	6	5	5	7	9	7	6	4	6	6	5	4	5
Southeast	9	9	9	9	10	10	10	7	9	10	10	8	8
South	10	11	10	7	8	10	11	10	10	13	13	11	10
Southwest	18	22	16	13	12	16	15	18	17	19	19	20	23
West	14	16	14	14	10	13	13	17	12	13	13	18	19
Northwest	14	14	13	19	16	13	11	13	13	11	13	15	15

* At stations of the U. S. Signal Service the observations were made at 7 A. M., 3 P. M, and 11 P. M., 75th meridan time.

† At 12 stations in 1878; 16 in 1879; 19 in 1880; 19 in 1881; 21 in 1882; 19 in 1883; 21 in 1884; 21 in 1885, and 16 in 1886.

TABLE XII.—*Number of Observations per Month (at 7 A. M., 2 P. M., and 9 P. M.,* daily), at which the wind was Blowing from each of the Eight Principal Points of Compass, during the Year and during each month of the Year 1886.—Average for 16 Stations in Michigan.†*

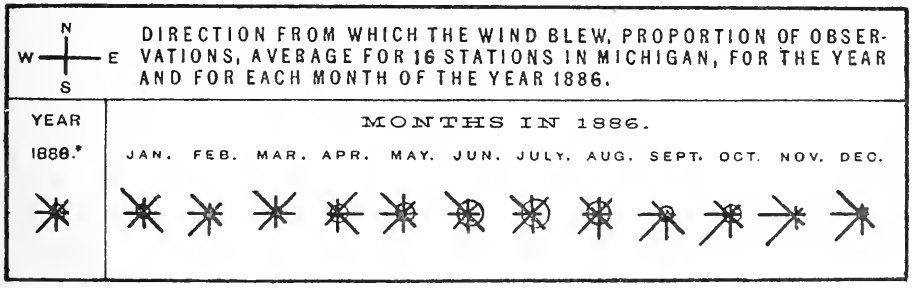
Points of Compass.	Average Number of Observations Per Month, 1886.												
	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
All observations ...	91	93	84	93	90	93	90	93	93	90	93	90	93
Calm.....	4	2	3	3	5	5	6	7	6	4	5	2	3
North.....	8	8	6	10	8	11	9	11	9	3	7	5	7
Northeast.....	10	12	8	15	15	10	8	13	12	3	8	5	5
East.....	6	8	6	9	12	7	6	5	6	5	4	5	4
Southeast.....	10	13	8	7	14	9	12	9	10	14	9	7	9
South.....	10	8	11	7	10	9	10	10	13	15	12	8	11
Southwest.....	16	12	16	13	10	15	11	13	15	20	22	21	19
West.....	12	11	12	12	6	12	11	10	9	15	14	20	17
Northwest.....	15	18	14	17	9	17	17	15	14	11	12	17	18

* At stations of the U. S. Signal Service the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th Meridian time.

† The names of observers, their places of observation, the counties and divisions of the State in which those places are situated are stated in Exhibit 1, page 30.

Graphic representations of statements in Table XII. are given in Diagram XIII., below.

DIAGRAM XIII.—WIND, DIRECTION, IN MICH., YEAR AND MONTHS, 1886.



*SCALE RADIUS .01 OF ONE INCH TO ONE OBSERVATION,
H. B. T., DEL. DES. BY H. B. B.

TABLE XIII.—*Average Number of Observations per Month for the Year 1886, at which the Wind was Blowing from each of the Eight Principal Points of the Compass, at each of 16 Stations in Michigan; also the Average for the 16 Stations.**

Stations in Michigan. (Those of the U. S. Signal Service in Italics.)	Divisions of the State.†	Average Number of Observations Per Month in 1886.									
		All Obs.	Calms	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
Av. for 16 stations	------	91	4	8	10	6	10	10	16	12	15
Marquette	U. P.	91	1	7	7	6	5	9	10	25	23
Escanaba	U. P.	91	1	21	13	2	3	17	17	6	12
Traverse City	N. W.	91	14	17	10	3	10	12	16	3	6
Mackinaw City	N.	91	3	7	5	12	9	8	12	19	17
Alpena	N. E.	91	3	6	5	9	15	7	10	23	13
Harrisville	N. E.	91	0	2	10	1	21	6	23	6	22
Grand Haven	W.	91	2	7	10	12	9	16	8	12	15
Pentwater	W.	91	0	4	10	4	11	5	16	11	30
Port Huron	B. & E.	91	1	9	18	4	7	21	12	10	9
Thornville	B. & E.	91	4	1	15	4	16	1	18	11	21
Agr'l College	C.	91	14	9	7	7	6	12	15	13	7
Lansing, S. B. of H.	C.	91	7	5	8	3	11	9	18	10	18
Ann Arbor	S. C.	91	1	10	6	9	10	13	16	15	12
Kalamazoo	S. C.	91	3	9	6	6	10	15	16	13	12
Marshall	S. C.	91	14	1	11	7	13	6	24	6	10
Detroit	S. E.	91	1	12	12	12	5	8	17	14	11

* The names of observers, their places of observation, and the counties and divisions of the State in which these places are situated are stated in Exhibit 1, page 30.

† The full names of the divisions, and the counties in each division, are stated in Exhibit I., in a paper which follows on weekly reports of sickness.

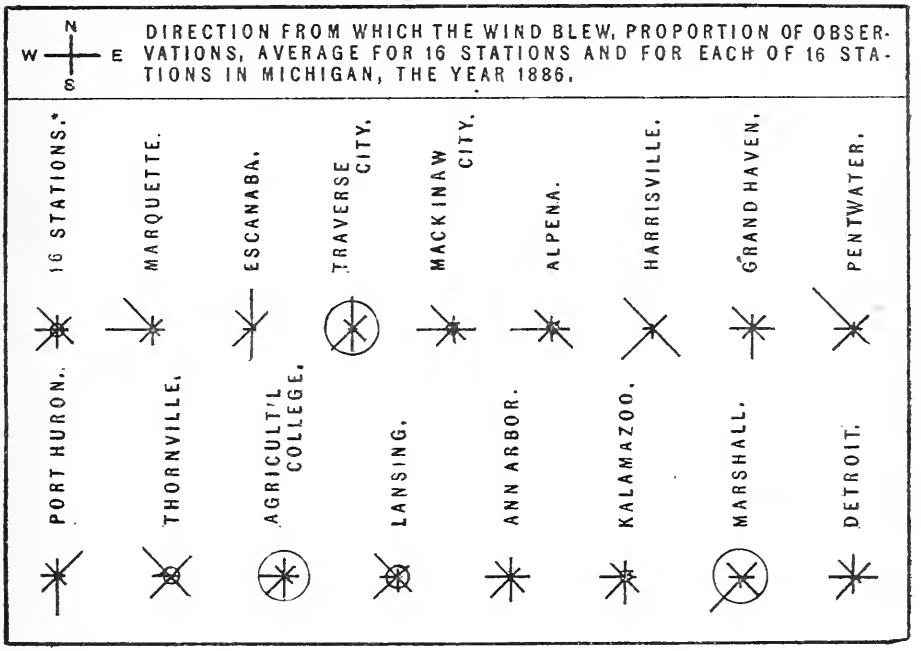
Graphic representations of statements in Table XIII. are given in Diagram XIV., page 93.

The construction and purport of the diagrams relating to direction of wind may be explained as follows:

In diagrams XII., XIII. and XIV., pages 98, 91 and 93, relating to direction of the wind, the single figures or separate groups of lines are designed to indicate by the length of the lines the number and the proportion of regular observations at 7 A. M., 2 P. M. and 9 P. M.,* daily, at which the wind was blowing from each of the eight principal points of compass at the places and for the periods of time stated in the margin; and by the direction of the lines on the page, the direction of the wind. Each figure consists of lines drawn to a common center from some or all of the following directions on the page and indicating that at the times of observation the wind blew from points of the compass as follows: Lines toward the common center from the top of the page indicate observations that the wind was blowing from the north; from the right-hand side, observations that the wind was from the east; from the bottom of the page, that it was from the south; from the left-hand side, that it was from the west; from the upper left-hand corner, that it was from the northwest; from the upper right-hand corner, that it was from the northeast; from the lower right-hand corner, that it was from the southeast; from the lower left-hand corner that it was from the southwest. The number of regular observations at which the wind was blowing from the direction denoted by a line is indicated by the length of that line, .01 of an inch being the unit or the length of line for one observation. Tht circles indicate calms, the number of regular observations at which there was no wind being denoted by the length of the *radius* of the circle drawn about the point of convergence of the lines for a given place or period of time, the length for one observation being, as before, .01 of an inch. Thus, by Diagram XII., page 98, or by Table XIV., pages 94-97, it appears that at Alpena, in August, 1886, at 10 of the regular tri-daily observations for the month there was a calm; at 16 observations the wind was blowing from the west; at 12 from the northwest; at 5 from the northeast, etc. For convenient study the top of these diagrams should be held toward the north. Definite numerical statements corresponding to these diagrams are given in Tables XII., XIII. and XIV., pages 91, 92, 94-97.

* At the stations of the U. S. Signal Service the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th meridian time.

DIAGRAM XIV.—WIND, DIRECTION, AT STATIONS IN MICHIGAN, 1886.



H. B. T., DEL. DES. BY H. B. B.

*SCALE, RADIUS .01 OF ONE INCH TO ONE OBSERVATION, NUMERICAL STATEMENTS CORRESPONDING TO LINES IN THIS DIAGRAM ARE GIVEN IN TABLE PAGE

TABLE XIV.—*Number of Observations for each Month of the Year 1886, at which the wind was Blowing from each of the Eight Principal Points of the Compass, at each of the 24 Stations* in Michigan; also the average for 16 of the said* Stations from which nearly Complete Observations were received for the Year. (Observations made at 7 A. M., 2 P. M., and at 9 P. M., Daily.)†*

Stations in Michigan. (Those of U. S. Signal Service in Italics.)	Divisions of the State.*	January.										February.										March.									
		Total.	Calm.	N.	N. E.	E.	S. E.	S.	S.W.	W.	N.W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S.W.	W.	N.W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S.W.	W.	N.W.
Av. for 16 Stat'n‡	.....	93	2	8	12	8	13	8	12	11	18	84	3	6	8	6	8	11	16	12	14	93	3	10	15	9	7	7	13	12	17
Marquette	U. P.	93	0	10	10	7	4	12	4	22	24	84	0	1	13	5	7	8	10	22	18	93	0	7	14	9	2	6	6	27	22
Manistique and Gulliver Lake§	U. P.	93	3	27	10	6	5	9	4	4	25	84	11	14	3	6	6	12	4	5	23	93	12	21	7	7	6	7	14	3	16
Escanaba	U. P.	93	1	27	20	3	0	6	13	5	18	84	1	16	14	1	3	11	16	5	17	93	1	34	24	2	2	13	10	2	5
Traverse City	N. W.	93	11	10	16	3	18	11	10	0	14	84	19	18	2	3	5	13	15	2	7	93	14	27	15	2	8	7	12	4	4
Mackinaw City	N.	93	4	11	19	12	8	8	6	6	19	84	0	11	5	15	9	8	7	13	16	93	1	9	7	20	4	2	15	17	18
Alpena	N. E.	93	0	7	7	8	9	12	4	25	21	84	0	5	6	11	6	13	7	20	16	93	3	6	8	16	11	2	7	22	18
Harrisville	N. E.	93	0	6	6	4	22	3	16	6	30	84	0	2	10	0	18	7	15	8	24	93	0	3	15	4	20	5	11	2	33
Grand Haven	W.	93	0	9	10	21	17	5	4	9	18	84	1	5	8	15	10	14	8	17	6	93	2	13	18	12	3	13	8	8	16
Pentwater	W.	93	0	5	26	8	24	0	6	8	16	84	0	5	16	6	13	0	24	7	13	93	0	8	20	13	8	6	11	6	21
Reed City	W.	90	0	10	5	7	14	14	12	20	8	84	0	23	3	5	3	24	11	13	2	93	0	6	15	15	14	12	6	16	9
East Saginaw	B. & E.	93	35	7	9	1	3	6	16	4	12	84	23	8	6	0	8	5	19	7	8	93	36	10	8	3	1	5	17	3	10
Port Austin	B. & E.	92	0	14	16	0	10	6	30	4	12	84	2	10	10	1	7	14	27	5	8	92	6	13	21	6	5	8	20	5	8
Port Huron	B. & E.	93	4	4	10	3	12	15	11	17	17	84	0	6	7	2	9	28	10	9	13	93	0	12	22	3	4	17	9	8	18
Thornville	B. & E.	93	2	0	18	0	14	0	17	7	35	84	3	1	9	2	7	8	15	20	19	93	5	5	17	7	6	0	21	11	21
Agr'l College	C.	93	3	8	10	8	14	14	12	15	9	84	3	4	7	4	7	17	19	14	9	93	11	3	14	16	3	7	9	22	8
Lansing, S.B. of H.	C.	93	3	7	7	8	15	9	14	14	16	84	6	6	6	2	7	10	21	8	18	93	6	3	14	4	11	8	13	13	21
Swartz Creek	C.	93	3	2	14	2	19	4	20	7	22	84	1	4	10	0	13	3	35	5	13	92	2	3	27	1	9	4	22	6	18
Otsego	S. W.	.....	.....	....	....	....	....	..	....	....	....	84	2	3	7	3	3	30	1	33	2	88	10	7	7	13	3	4	12	29	3
Ann Arbor	S. C.	93	0	8	8	10	12	10	15	16	14	83	0	7	5	9	5	18	14	13	12	93	0	9	9	11	7	10	14	11	22
Battle Creek	S. C.	91	1	5	8	12	31	2	12	15	5	84	1	2	5	15	8	14	8	12	19	.....	.....	....	....	....	....	..	....	....	....
Kalamazoo	S. C.	93	0	9	7	8	15	10	27	6	11	84	0	4	8	0	7	13	34	6	12	93	0	8	13	0	6	8	18	13	27
Marshall	S. C.	93	5	1	10	12	18	2	27	10	8	84	9	1	6	6	11	7	23	10	11	93	8	0	14	11	13	0	30	6	11
Birmingham	S. E.	91	9	16	8	10	6	7	15	13	7	83	11	14	2	7	5	7	15	18	4	89	13	10	7	10	9	5	10	13	12
Detroit	S. E.	93	0	12	9	10	9	11	9	17	16	84	0	11	5	7	2	7	21	16	15	93	1	15	14	16	3	7	11	12	14

Diagram XII, page 98, gives 14 lines in this table, and is explained on page 92. * For names of observers, etc., see Exhibit 1, page 30. For names of divisions, etc., see Exhibit I. in a paper which follows, on weekly reports of sickness. † With exceptions stated for U. S. Signal Service Stations in Table I, page 47. ‡ This line includes only the 16 stations from which statements complete, or nearly complete, were received for every month of the year; it does not include Manistique and Gulliver Lake, Reed City, Port Austin, Swartz Creek, Otsego, Battle Creek, and Birmingham. § The observations compiled in this line were made at Manistique until June 1, After that date they were made by the same observer at Gulliver Lake. Gulliver Lake, is about 12 miles east from Manistique.

TABLE XIV.—CONTINUED.—*Direction of Wind, Months in 1886.—Observations at which the Wind was blowing from Direction named.*

Stations in Michigan. (Those of U. S. Signal Service in Italics.)	Divisions of the State.*	April.										May.										June.									
		Total.	Calm.	N.	N. E.	E.	S. E.	S.	S.W.	W.	N.W.	Total.	Calm.	N.	N. E	E.	S. E.	S.	S.W.	W.	N.W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S.W.	W.	N.W.
Av. for 16 sta'ns.‡	.....	90	5	8	15	12	14	10	10	6	9	93	5	11	10	7	9	9	15	12	17	90	6	9	8	6	12	10	11	11	17
Marquette	U. P.	90	3	4	15	9	6	16	6	10	21	93	1	13	3	9	7	5	9	24	22	90	0	9	5	9	7	6	10	15	29
Manistique and Gulliver Lakes§	U. P.	90	20	9	5	4	12	20	7	2	11	93	11	10	5	4	12	23	11	3	14	90	9	14	1	2	14	15	9	2	24
Escanaba	U. P.	90	0	17	20	4	8	31	3	0	7	93	0	24	14	3	0	32	11	0	9	90	1	25	9	0	7	30	10	1	7
Traverse City	N. W.	90	19	22	10	6	9	16	4	0	4	93	15	23	19	5	10	7	10	1	3	90	25	25	15	3	8	3	8	1	2
Mackinaw City	N.	90	6	7	3	23	16	4	2	14	15	93	4	4	3	10	10	4	11	25	22	90	6	3	2	17	9	5	8	22	18
Alpena	N. E.	90	6	9	8	22	22	2	4	9	8	93	2	10	3	8	21	5	6	17	21	90	3	8	4	7	27	4	5	19	13
Harrisville	N. E.	90	0	2	21	0	28	5	13	3	18	93	0	2	18	1	30	7	11	3	21	90	0	3	3	0	24	8	26	6	20
Grand Haven	W.	90	2	6	13	24	7	13	6	8	12	93	1	8	8	11	2	22	11	16	14	90	3	4	6	9	11	10	9	14	24
Pentwater	W.	90	0	3	10	3	19	6	14	7	28	93	0	7	4	4	3	6	26	10	33	90	0	1	2	2	3	7	9	17	49
Reed City	W.	73	0	3	2	4	14	26	12	5	7	93	0	3	0	12	5	29	13	22	9	89	0	4	0	2	0	28	22	12	21
East Saginaw	B. & E.	90	43	8	16	4	5	5	7	1	1	89	34	9	10	4	1	4	21	2	4	60	25	4	2	3	2	3	8	7	6
Port Austin	B. & E.	90	7	5	27	6	15	10	10	4	6	89	16	11	16	13	5	4	16	6	2	90	11	10	19	2	10	16	12	3	7
Port Huron	B. & E.	90	1	15	28	9	11	14	6	4	2	93	1	20	23	3	2	25	9	5	5	90	0	13	29	5	5	22	3	7	6
Thornville	B. & E.	90	6	0	27	7	16	0	18	9	7	93	6	0	17	6	10	2	15	3	34	90	2	0	15	4	27	0	10	8	24
Agr'l College	C.	90	16	7	12	17	11	10	10	7	0	93	26	13	5	8	2	5	11	17	6	90	24	11	5	4	9	11	9	11	6
Lansing, S. B. of H.	C.	90	7	5	17	5	19	8	16	4	9	93	11	7	11	2	9	3	13	11	26	90	8	3	6	1	14	7	14	11	26
Swartz Creek	C.	90	2	3	27	2	23	2	20	4	7	92	1	4	17	1	7	0	38	3	21	90	5	3	9	2	15	7	26	1	22
Otsego	S. W.	87	7	8	7	17	15	21	1	11	0	61	9	1	5	10	5	2	5	21	3	84	4	4	5	2	3	6	5	53	2
Ann Arbor	S. C.	90	0	11	14	18	17	10	8	9	3	93	0	10	6	7	9	10	14	19	18	90	0	10	5	12	14	14	9	13	13
Battle Creek	S. C.	86	3	4	16	18	11	6	18	7	3	93	13	2	10	14	6	10	10	13	15	90	1	3	9	11	22	3	18	16	7
Kalamazoo	S. C.	90	1	14	7	12	13	17	13	6	7	93	2	15	4	2	6	3	27	17	17	90	1	6	6	2	11	14	18	11	21
Marshall	S. C.	90	8	2	18	10	23	4	20	2	3	93	14	0	13	14	6	1	29	7	9	90	19	1	8	3	14	7	19	9	10
Birmingham	S. E.	84	13	11	5	18	12	6	6	8	5	92	17	9	7	5	9	5	8	13	19	87	23	6	9	2	10	4	11	7	15
Detroit	S. E.	90	3	6	18	24	6	9	11	8	5	93	0	18	14	12	9	3	19	10	8	90	1	17	13	15	2	12	14	10	6

* ‡ § For these references see foot-notes to this table on page 94.

NOTE.—Graphic representations of statements for 14 lines in this table are given in Diagram XII., page 98, which is explained on page 92.

TABLE XIV.—CONTINUED.—*Direction of Wind, Months in 1886.—Observations at which the Wind was Blowing from Directions Named.*

Stations in Michigan.* (Those of U. S. Signal Service in Italics.)	Divisions of the State.*	July.										August.										September.									
		Total.	Calm.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
Av. for 16 Stat'ns	-------	93	7	11	13	5	9	10	13	10	15	93	6	9	12	6	10	13	15	9	14	90	4	3	3	5	14	15	20	15	11
Marquette	U. P.	93	0	8	8	8	9	4	6	21	29	93	1	8	6	6	6	9	14	20	23	90	1	2	2	6	5	15	17	29	13
Manistique and Gulliver Lakes§	U. P.	93	17	17	4	3	3	17	16	1	15	93	12	19	2	2	10	24	3	2	19	90	2	7	1	3	16	25	13	8	15
Escanaba	U. P.	93	2	27	11	1	3	28	16	2	3	93	1	20	16	1	4	13	24	4	10	90	0	10	5	2	7	20	24	16	6
Traverse City	N. W.	93	18	26	12	1	19	6	5	2	4	93	19	23	15	1	16	3	13	2	1	90	5	5	5	1	3	20	33	10	8
Mackinaw City	N.	93	7	9	2	5	7	7	15	25	16	93	3	7	5	11	9	10	7	21	20	90	0	3	2	12	13	7	20	19	14
Alpena	N. E.	93	4	5	6	6	19	10	7	23	13	93	10	8	5	4	24	7	7	16	12	90	3	2	2	7	20	9	17	23	7
Harrisville	N. E.	93	0	2	9	1	23	11	26	6	15	92	0	1	10	0	22	5	30	4	20	90	0	0	4	0	21	8	31	7	19
Grand Haven	W.	93	3	7	11	7	6	16	9	15	19	93	5	7	8	9	12	21	6	12	13	90	1	3	5	12	15	22	6	12	14
Pentwater	W.	93	0	6	4	0	3	7	21	10	42	93	0	3	5	0	7	11	21	8	38	90	0	5	4	4	21	8	17	12	19
Reed City	W.	86	0	20	1	3	5	19	18	15	5	------	------	----	----	----	----	----	----	----	----	------	------	----	----	----	----	----	----	----	----
East Saginaw	B. & E.	83	45	12	4	4	0	1	15	1	1	89	50	4	2	1	2	6	14	6	4	87	36	0	5	1	7	6	25	4	3
Port Austin	B. & E.	93	17	11	13	8	9	13	10	10	2	77	11	7	11	7	3	14	14	5	5	90	6	2	7	5	10	18	16	21	5
Port Huron	B. & E.	93	3	18	34	1	4	13	14	2	4	93	0	15	31	2	3	29	3	6	4	90	0	1	8	4	8	31	19	11	8
Thornville	B. & E.	93	4	0	37	2	17	0	9	3	21	93	2	0	18	13	15	1	21	10	13	90	6	0	3	1	30	3	23	11	13
Agr'l College	C.	93	22	20	13	4	3	8	5	13	5	93	17	16	6	8	4	24	8	5	5	90	11	2	3	2	9	20	24	11	8
Lansing S. B. of H.	C.	93	17	4	12	1	7	8	10	7	27	93	10	11	12	2	7	19	15	4	13	90	7	0	0	2	17	11	27	14	12
Swartz Creek	C.	93	6	9	16	6	3	0	27	8	18	93	2	4	20	0	12	2	40	1	12	90	0	1	5	0	10	10	46	7	11
Otsego	S. W.	89	2	0	2	14	1	0	3	67	0	91	0	6	2	31	2	19	7	15	9	77	1	2	0	5	6	31	18	14	0
Ann Arbor	S. C.	93	5	24	5	14	6	11	10	11	7	90	0	10	5	13	10	18	10	13	11	90	0	3	2	4	15	21	19	22	4
Battle Creek	S. C.	93	3	8	10	17	8	13	5	15	14	93	3	6	5	7	20	19	10	11	12	------	------	----	----	----	----	----	----	----	----
Kalamazoo	S. C.	93	10	8	12	7	4	10	10	20	12	93	6	9	11	7	12	17	9	6	16	90	5	4	1	8	20	22	9	15	6
Marshall	S. C.	93	19	2	15	5	7	5	28	3	9	93	14	3	14	9	7	10	24	2	10	90	24	1	3	2	19	12	14	8	7
Birmingham	S. E.	------	------	----	----	----	----	----	----	----	----	------	------	----	----	----	----	----	----	----	----	------	------	----	----	----	----	----	----	----	----
Detroit	S. E.	93	0	13	20	19	2	10	19	4	6	93	0	7	20	16	2	8	23	9	8	90	0	8	1	8	7	13	24	16	13

*, †, ‡, §. For these references see foot notes to this table on page 94.

NOTE.—Graphic representations of statements for 14 lines in this table are given in Diagram XII, page 98, which is explained on page 92.

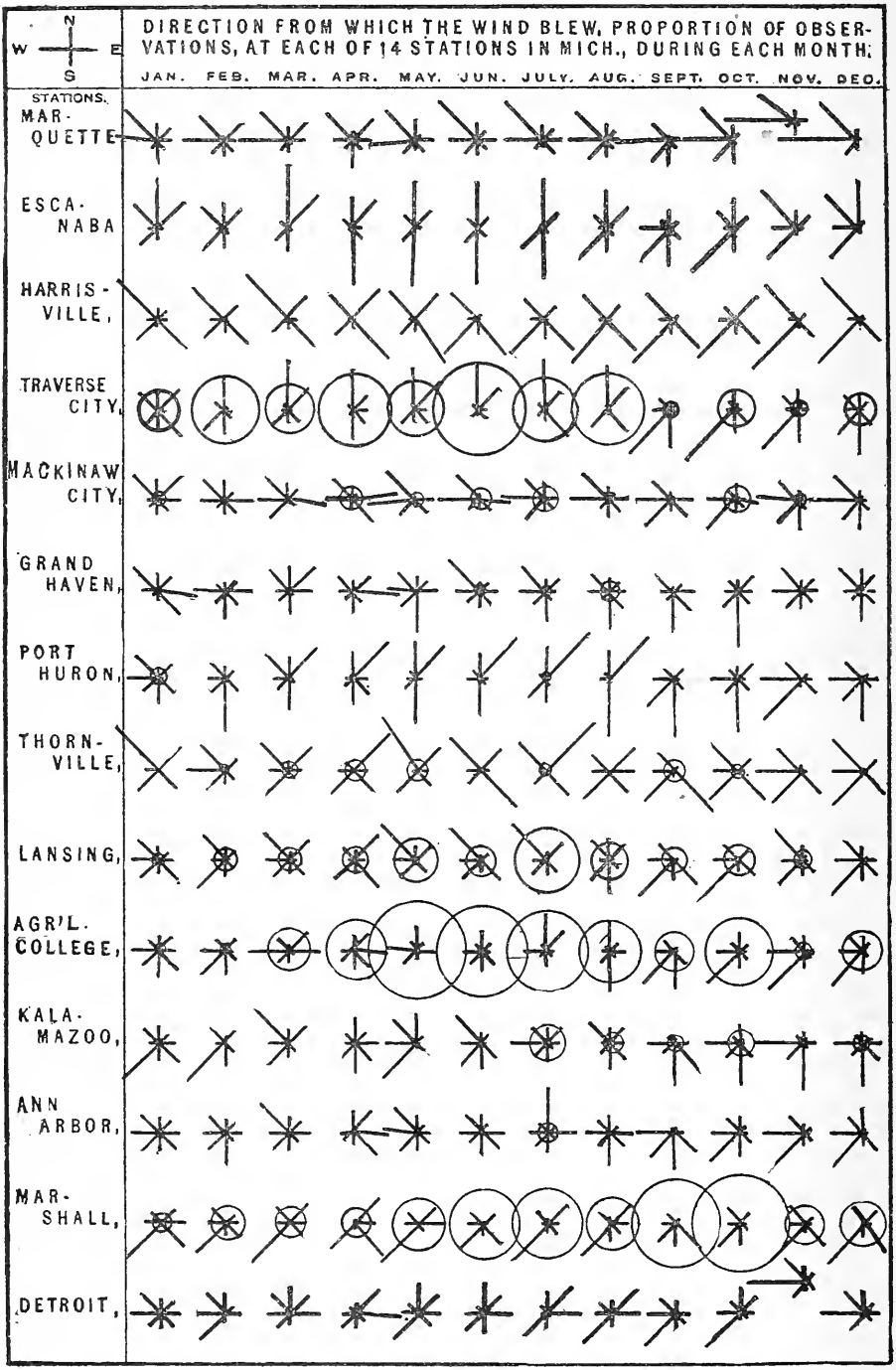
TABLE XIV.—CONCLUDED.—*Direction of Wind, Months in 1886.—Observations at which the Wind was Blowing from Directions Named.*

Stations in Michigan.* (Those of U. S. Signal Service in Italics.)	Divisions of the State.*	October.										November.										December.									
		Total.	Calm.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Total.	Calm.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
Av. for 16 stations	.....	93	5	7	8	4	9	12	22	14	12	90	2	5	5	5	7	8	21	20	17	93	3	7	5	4	9	11	19	17	18
Marquette	U. P.	93	1	6	4	1	3	13	15	27	23	90	0	5	2	5	3	7	6	38	24	93	1	5	0	2	0	6	11	42	26
Manistique and Gulliver Lake§	U. P.	93	10	14	9	0	10	26	13	3	8	90	6	13	5	4	6	15	7	12	22	93	6	14	4	1	3	15	10	13	27
Escanaba	U. P.	93	0	17	10	0	2	13	33	5	13	90	0	10	9	3	2	2	23	13	28	93	0	24	5	0	0	3	22	14	25
Traverse City ...	N. W.	93	10	10	1	3	8	13	38	5	5	90	4	11	5	4	4	17	28	6	11	93	9	8	5	1	10	25	18	6	11
Mackinaw City ..	N.	93	7	10	2	11	6	7	25	17	8	90	3	5	4	3	6	16	15	23	15	93	0	6	1	4	7	16	13	27	19
Alpena	N. E.	93	2	10	8	3	17	6	15	22	10	90	2	3	1	9	3	6	21	38	8	93	1	3	1	1	5	13	17	40	13
Harrisville.....	N. E.	93	0	1	17	1	18	7	29	11	9	90	0	1	5	0	12	4	37	5	26	93	0	0	2	1	16	4	33	7	30
Grand Haven....	W.	93	0	6	12	8	10	30	12	7	8	90	0	6	9	9	10	10	13	16	17	93	3	12	11	8	10	16	6	9	18
Pentwater	W.	93	0	2	11	0	6	9	15	19	31	90	0	4	10	7	8	2	13	16	30	88	0	4	8	4	14	1	14	8	35
Reed City.....	W.	-----	-----	----	----	----	----	--	----	----	----	-----	-----	----	----	----	----	----	----	----	----	-----	-----	----	----	----	----	----	----	----	----
East Saginaw....	B. & E.	93	39	3	6	0	8	0	28	7	2	90	29	1	0	1	1	6	35	11	6	93	38	4	1	0	2	9	18	15	6
Port Austin.....	B. & E.	87	8	10	5	7	7	13	22	8	7	-----	-----	----	----	----	----	----	----	----	----	-----	-----	----	----	----	----	----	----	----	----
Port Huron.....	B. & E.	93	1	6	11	5	8	29	10	15	8	90	0	0	4	6	11	5	30	22	12	93	0	3	4	9	6	25	17	17	12
Thornville.....	B. & E.	93	4	0	10	3	21	0	21	13	21	90	2	3	0	3	16	0	23	25	18	93	2	0	9	1	16	3	24	15	23
Agr'l College....	C.	93	18	10	5	4	5	9	24	12	6	90	5	8	2	5	4	9	28	19	10	93	11	9	6	2	4	12	25	13	11
Lansing, S.B. of H.	C.	93	8	1	7	0	11	6	33	14	13	90	5	7	2	2	10	10	20	11	23	93	1	8	3	6	10	11	25	14	15
Swartz Creek....	C.	93	3	2	12	0	10	8	37	4	17	90	1	0	7	1	8	2	40	11	20	93	3	4	6	0	8	7	38	10	17
Otsego.....	S. W.	90	4	0	0	7	17	9	13	40	0	76	0	0	0	8	6	5	17	34	6	91	10	2	1	7	1	23	15	31	1
Ann Arbor.....	S. C.	93	1	9	5	5	9	14	23	16	11	90	1	5	5	4	6	7	29	21	12	91	0	13	3	1	12	8	24	18	12
Battle Creek.....	S. C.	91	4	6	3	7	19	13	16	13	10	85	0	1	5	6	11	21	9	29	3	89	0	1	5	3	15	33	3	24	5
Kalamazoo	S. C.	93	7	12	3	3	10	22	11	19	6	90	3	7	1	7	4	25	12	26	5	93	4	9	3	10	12	23	9	16	7
Marshall.....	S. C.	93	26	0	10	3	6	12	18	7	11	90	11	2	6	3	15	5	27	8	13	93	12	0	10	3	18	7	29	3	12
Birmingham.....	S. E.	90	21	8	5	1	7	7	16	8	17	86	2	3	4	4	3	10	16	19	25	90	3	5	5	1	4	14	19	18	21
Detroit.....	S. E.	93	1	14	12	7	4	5	27	14	9	90	0	10	7	3	5	5	10	32	18	93	0	14	8	9	6	4	13	23	16

*, †, ‡, §. For these references see foot-notes to this Table on page 94.

NOTE.—Diagram XII, page 98, exhibits lines showing, by months, directions of wind at each of 14 stations in this table, the cut for each month and station in said diagram representing the figures given in this table for the same month and station; it is explained on page 92.

DIAGRAM XII.—WIND, DIRECTION, AT STATIONS, BY MONTHS, IN 1888.



SCALE RADIUS .01 OF ONE INCH TO ONE OBSERVATION.
H. B. T., DEL. DES. BY H. B. B.

EXHIBIT 29.—*Average Atmospheric Pressure, by Year and Months, in 1886, compared with Annual and Monthly Average for 1885, and for the ten Years 1877-86. These Averages are for Groups of several Stations in Michigan.**

Years, etc.	Average Atmospheric Pressure.—Inches of Mercury.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 10 yrs, 1877-86*	29.158	29.203	29.190	29.143	29.124	29.124	29.106	29.113	29.143	29.187	29.202	29.173	29.181
1885 (19 stations*)	29.152	29.200	29.119	29.186	29.194	29.092	29.181	29.126	29.151	29.195	29.145	29.092	29.135
1886 (15 stations*)	29.192	29.188	29.198	29.126	29.230	29.128	29.161	29.159	29.166	29.222	29.331	29.137	29.262
In 1886 Greater than Av. for 10 yrs., 1877-86	.034	.....	.008	.....	.106	.004	.055	.046	.023	.035	.129	.....	.081
In 1886 Less than av. for 10 yrs., 1877-86	.....	.015	.....	.017	.....	.....	.....	.....	.....	.....	.....	.036	.....
In 1886 Greater than in 1885	.040	.....	.079	.....	.036	.036	.....	.033	.015	.027	.186	.045	.127
In 1886 Less than in 1885	.....	.012	.....	.060	.....	.....	.020	.....	.....	.....	.....	.....	.....

*See foot-note on page 101.]

EXHIBIT 30.—*Comparisons of the Average Atmospheric Pressure during the Year and during each Month of the Year 1886, with Averages for the 11 Years, 1875-85, and for the Year 1885. Corrected for Temperature and for Instrumental Error. Observations made at 7 A. M., 2 P. M., and 9 P. M., Daily, by Prof. R. C. Kedzie, at the State Agricultural College, near Lansing, Mich.*

Years, etc.	Average Atmospheric Pressure.—Inches of Mercury.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 11 yrs., 1875-85	29.058	29.085	29.061	29.011	29.013	29.037	29.032	29.050	29.070	29.104	29.074	29.078	29.080
1885	29.068	29.144	29.006	29.093	29.097	28.988	29.105	29.052	29.061	29.115	29.056	29.013	29.062
1886	29.089	29.061	29.093	29.000	29.113	29.023	29.055	29.051	29.049	29.135	29.253	29.061	29.173
In 1886 Greater than av. for 11 yrs., 1875-85	.031	.....	.032	.....	.100	.....	.023	.001	.....	.031	.179	.....	.093
In 1886 Less than av. for 11 yrs., 1875-85	.....	.024	.....	.011	.....	.014	.....	.....	.021	.....	.....	.017	.....
In 1886 Greater than in 1885	.021	.....	.087	.....	.016	.035	.....	.....	.....	.020	.197	.048	.111
In 1886 Less than in 1885	.....	.083	.....	.093	.....	.....	.050	.001	.012	.....	.....	.....	.....

EXHIBIT 31.—*Average Daily Range of Atmospheric Pressure, by Year and Months, in 1886, Compared with Annual and Monthly Averages for 1885, and for the five years, 1882-86. These Averages are for Groups of Several Stations in Michigan.*

Years, Etc.	Average Daily Range of Barometer.—Year and Months, 1886.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 5 yrs., 1882-86*..	.212	.314	.299	.288	.199	.168	.146	.122	.137	.162	.208	.236	.261
1885—(18 stations*)..	.209	.319	.217	.267	.253	.148	.165	.118	.165	.173	.182	.181	.314
1886—(14 stations*)..	.205	.270	.324	.248	.166	.157	.131	.112	.142	.187	.229	.269	.220
In 1886 **Greater** than Av. for 5 yrs., 1882-86.....	.....	.....	.025	.....	.....	.....	.....	.....	.005	.025	.021	.033	.....
In 1886 **Less** than Av. for 5 yrs., 1882-86.....	.007	.044	.....	.040	.033	.011	.015	.010	.....	.....	.....	.....	.041
In 1886 **Greater** than in 1885.....	.....	.....	.107	.....	.....	.009	.....	.....	.....	.014	.047	.088	.....
In 1886 **Less** than in 1885.....	.004	.049	.....	.019	.087	.....	.034	.006	.023	.....	.....	.....	.094

* Marquette for 1882-4 and 1886; Escanaba, Traverse City, Grand Haven, Lansing, Ann Arbor for 1882-6; Reed City, Tecumseh for 1882-5; Alpena, Port Huron, Agricultural College, Detroit, Marshall, for 1883-6; Port Austin for 1883-4; Washington for 1883; Mendon for 1883; Manistique, Ionia for 1884-5; Mackinaw City, Thornville for 1884-6; Harrisville for 1885-6; Swartz Creek for 1885; Kalamazoo for 1886.

EXHIBIT 32.—*Range of Atmospheric Pressure, by Year and Months, in 1886, compared with Annual and Monthly Averages for 1885, and for the five years 1882-86. These Averages are for Groups of Several Stations in Michigan.*

Years, Etc.	Range of Barometer.—Year and Months, 1886.												
	Annual Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 5 yrs., 1882-86*..	.932	1.187	1.205	1.196	1.034	.761	.702	.563	.648	.821	1.014	1.004	1.123
1885 (18 stations.*)..	.906	1.356	1.160	1.068	.930	.709	.655	.525	.808	.737	.809	.800	1.317
1886 (14 stations.*)..	.941	1.013	1.320	1.339	1.103	.728	.600	.506	.597	.717	1.406	1.213	1.108
In 1886 **Greater** than Av. for 5 yrs. 1882-86.....	.009	.....	.115	143	.069	.....	.....	.....	.....	.....	.392	.209	.....
In 1886 **Less** than Av. for 5 yrs., 1882-86.....	.....	.174	.....	.....	.....	.033	.102	.057	.051	.104	.....	.....	.015
In 1886 **Greater** than in 1885.....	.035	.....	.160	.271	.173	.019	.....	.....	.....	.....	.597	.413	.....
In 1886 **Less** than in 1885.....	.....	.343	.....	.....	.....	.....	.055	.019	.211	.020	.....	.....	.209

* Marquette for 1882-4 and 1886; Escanaba, Traverse City, Grand Haven, Lansing, Ann Arbor for 1882-6; Reed City, Tecumseh for 1882-5; Alpena, Port Huron, Agricultural College, Detroit for 1883-6; Port Austin for 1883-4; Washington, Mendon for 1883; Marshall for 1883-5; Manistique, Ionia for 1884-5; Mackinaw City, Thornville for 1884-6; Harrisville for 1885-6; Swartz Creek for 1885; Kalamazoo for 1886.

TABLE XV.—*Average Daily Range of Atmospheric Pressure (as determined from three daily observations*) for the Year 1886, at each of 15 Stations, and the average for the same Stations in Michigan.—Stations arranged in order by Latitude, those farthest North first.*

Stations in Michigan.† (Those of the U. S Signal Service in italics.)	Average Daily Range of Barometer.—Year and Months, 1886.													
	Norm. ‡	1885.	1886.	Jan.	Feb.	Mar.	Apr.	May	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 15 Stations	.....	.....	.203	.267	.322	.247	.165	.155	.130	.109	.141	.186	.226	.266	.218
Av. for 14 Stations¶	.....	.....	.205	.270	.324	.248	.166	.157	.131	.112	.142	.187	.229	.269	.220
Marquette	..... ^{5}	.....	.211	.250	.332	.237	.174	.183	.119	.145	.132	.193	.255	.302	.213
Escanaba	.222 ^{3}	.207	.209	.256	.352	.249	.168	.172	.121	.134	.137	.179	.246	.291	.204
Mackinaw City	.218 ^{4}	.211	.211	.275	.364	.264	.149	.162	.128	.120	.136	.181	.237	.296	.214
Alpena	.224 ^{5}	.216	.213	.287	.350	.253	.163	.157	.139	.120	.139	.196	.239	.282	.227
Traverse City	.220 ^{2}	.215	.209	.265	.334	.258	.164	.172	.127	.135	.142	.179	.254	.284	.192
Harrisville	.227 ^{5}	.227	.226	.274	.343	.272	.171	.178	.159	.130	.169	.222	.261	.270	.267
Grand Haven	.206 ^{4}	.200	.199	.248	.314	.244	.164	.157	.135	.107	.144	.183	.235	.261	.201
Port Huron	.213 ^{3}	.220	.201	.288	.312	.242	.171	.140	.134	.095	.142	.190	.201	.267	.227
Thornville	.205 ^{4}	.203	.201	.305	.303	.240	.160	.155	.128	.098	.146	.188	.210	.252	.224
Agr'l College	.203 ^{5}	.198	.198	.264	.310	.238	.167	.139	.127	.093	.141	.178	.222	.268	.228
Lansing, S. B. of H	.206 ^{4}	.202	.193	.255	.303	.237	.160	.133	.135	.099	.143	.183	.214	.248	.203
Detroit	.211 ^{2}	.212	.197	.281	.306	.239	.176	.138	.131	.094	.142	.183	.197	.254	.226
Swartz Creek	.209 ^{5}	.213	.204	.276	.323	.243	.167	.142	.131	.102	.152	.188	.240	.260	.223
Ann Arbor	.205 ^{4}	.199	.199	.269	.294	.242	.179	.176	.126	.091	.137	.178	.202	.266	.237
Marshall	.210 ^{2}	.206	.198	.265	.312	.254	.158	.140	.127	.100	.143	.190	.226	.237	.218
Kalamazoo	.181	.186	.176	.230	.294	.230	.146	.122	.116	.080	.123	.161	.190	.224	.193

* At stations of the U. S. Signal Service the observations were made at 7 A. M., 3 P. M., and 11 P. M., 75th Meridian time. The corresponding local time for each of these stations is stated in star (*) footnote to Table I., page 47.

† The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit 1, page 30. The average atmospheric pressure at each of these stations, by months, in 1886, is given in Table XVII., page 103.

‡ Numbers in this column state the average daily range of atmospheric pressure for periods of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the average daily range, denote the number of years included in the average.

¶ Not including Kalamazoo.

NOTE.—The latitude and elevation of some of these stations are stated in Exhibit 2, page 31.

Foot-note from page 99.]

* Kalamazoo for 1877–82 and 1885-6; Battle Creek for 1877–80 and 1882; Detroit for 1878-86; Woodmere Cemetery (near Detroit) for 1877-9; Mendon for 1877-8 and 1881-3; Marquette for 1879-84 and 1886; Alpena, Grand Haven, Port Huron, Lansing for 1879-86; Benton Harbor for 1877-8; Ypsilanti for 1877 and 1879; Agricultural College for 1877 and 1881-6; Otisville for 1878-80 and 1882; Tecumseh for 1879-80 and 1882-5; Washington for 1879-80 and 1882-3; Nirvana for 1879 and in 1880 to April 25, inclusive; Reed City, for 1880 after April 25, and 1881-5; Thornville for 1880-1 and 1884-6; Escanaba for 1880 and 1882-6; Ann Arbor for 1881-6; Traverse City for 1882-6; Harrisville for 1882 and 1885-6; Hastings for 1882; Hillsdale for 1882-3; Port Austin for 1883-4; Marshall for 1883-6; Manistique, Ionia for 1884-5; Mackinaw City 1884-6; Swartz Creek for 1885.

TABLE XVI.—*Range of Atmospheric Pressure (as determined from 3 daily observations*) for the year and for each month and for the average month of the Year 1886, at 15 and at each of the 15 Stations† in Michigan; also the Norm.—Average Monthly Range for a series of Years.—Stations named in order by Latitude, those farthest North first.*

Stations in Michigan.‡ (Those of the U. S. Signal Service in Italics.)	Range of Barometer.—Year and Months, 1886.														
	Norm. ††	1885.	1886.	Av. Month	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
For 14 stations¶	.....	.....	1.927	1.425	1.540	1.658	1.872	1.575	1.429	1.040	.875	.990	1.129	1.838	1.560	1.589
Av. 15 stations‖	.....	.....	1.927	.963	1.007	1.311	1.337	1.091	.722	.594	.500	.590	.708	1.402	1.197	1.103
Av. 14 stations**	.....	.....	1.927	.941	1.013	1.320	1.339	1.103	.728	.600	.506	.597	.717	1.406	1.213	1.108
Marquette	.....	.....	1.644	.972	.784	1.260	1.327	1.084	.700	.528	.601	.615	.847	1.423	1.387	1.105
Escanaba	.978 5	1.413	1.600	1.004	.954	1.447	1.409	1.185	.646	.568	.574	.590	.782	1.483	1.332	1.073
Traverse City	.977 3	1.477	1.586	1.008	1.044	1.479	1.363	1.205	.617	.610	.578	.604	.677	1.581	1.260	1.074
Mackinaw City	.977 4	1.464	1.672	.999	.962	1.511	1.386	.903	.663	.649	.509	.592	.697	1.649	1.340	1.125
Alpena	1.001	1.554	1.594	1.036	.964	1.462	1.372	1.328	.665	.687	.541	.598	.764	1.578	1.319	1.157
Harrisville	 5	1.471	1.547	1.027	.914	1.382	1.355	1.260	.697	.693	.570	.678	.798	1.527	1.219	1.234
Grand Haven	.920 4	1.532	1.530	.943	1.003	1.272	1.393	1.058	.689	.560	.471	.590	.701	1.419	1.095	1.069
Port Huron	.963 3	1.507	1.443	.974	1.186	1.275	1.310	1.127	.739	.634	.465	.621	.724	1.288	1.208	1.108
Thornville	.947 4	1.437	1.457	.945	1.093	1.168	1.288	1.117	.781	.586	.454	.604	.720	1.293	1.115	1.119
Agr'l College	.901 5	1.433	1.480	.929	1.002	1.179	1.302	1.086	.717	.561	.482	.544	.621	1.374	1.192	1.086
Lansing, S.B. of H.	.910 2	1.457	1.446	.931	.975	1.289	1.302	1.106	.700	.576	.459	.575	.655	1.323	1.106	1.101
Swartz Creek	.949 5	1.464	1.479	.972	1.056	1.329	1.306	1.123	.680	.629	.496	.594	.739	1.386	1.169	1.159
Ann Arbor	.904 2	1.444	1.430	.963	1.150	1.231	1.275	1.001	1.124	.578	.443	.573	.694	1.220	1.179	1.083
Kalamazoo	.856 4	1.434	1.463	.864	.921	1.179	1.318	.928	.644	.507	.413	.488	.585	1.361	.978	1.041
Marshall	.905 4	1.414	1.525	.906	.970	1.243	1.351	.921	.703	.557	.473	.588	.629	1.286	1.081	1.074
Detroit	.925	1.488	1.468	.953	1.181	1.283	1.307	1.060	.744	.612	.466	.588	.724	1.223	1.143	1.101

¶ Represents the difference between the highest of 14 stations and lowest of 14 stations for year and for each month of year.

‖ Represents sum of ranges at 15 stations divided by 15.

** Not including Kalamazoo.

†† Numbers in this column state the average monthly range of atmospheric pressure for a period of years ending in each case with Dec. 31, 1886. The small figures above and at the right of numbers which state the average, denote the number of years included in the average.

NOTE.—The *, †, ‡ references and the note to Table XV., page 101, apply also to Table XVI.

TABLE XVII.—*Average Atmospheric Pressure for the Year, and for each Month in the Year 1886, at each of 15 Stations in Michigan, and also the Average for the same Stations, as indicated by the Height, in inches, of Mercury in the Barometer. Corrected for Temperature,—Reduced to 32° F. (for some Stations not corrected for Instrumental Errors*).—Average of Observations made Daily at 7 A. M., 2 P. M., and 9 P. M.,† by Observers‡ for the State Board of Health and for the U. S. Signal Service.*

Stations in Michigan.‡ (Those of the U. S. Signal Service in Italics.)	Divisions of the State.‡	Inches of Mercury.—Atmospheric Pressure. Years. Norm.§	1886.	Months, 1886. Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. for 14 stations*			29.213	29.208	29.216	29.146	29.250	29.146	29.181	29.181	29.188	29.243	29.353	29.158	29.283
Av. for 15 stations‖			29.192	29.188	29.198	29.126	29.230	29.128	29.161	29.159	29.166	29.222	29.331	29.137	29.262
*Marquette**	U. P.		29.257	29.295	29.253	29.231	29.323	29.209	29.234	29.236	29.225	29.227	29.359	29.174	29.318
Manistique and Gulliver Lake A.	U. P.		**	29.364	29.316	29.301					29.274	[g]29.324	29.433	29.228	29.353
*Escanaba**	U. P.	29.324 5	29.331	29.370	29.339	29.299	29.395	29.267	29.289	29.293	29.291	29.315	29.446	29.258	29.406
Traverse City	N. W.	29.337 5	29.307	29.337	29.328	29.287	29.093	29.281	29.298	29.302	29.301	29.346	29.462	29.264	29.390
*Mackinaw City**	N.	29.320 3	29.322	29.344	29.322	29.278	29.409	29.261	29.283	29.284	29.289	29.324	29.449	29.213	29.376
*Alpena**	N. E.	29.355 14	29.333	29.341	29.331	29.273	29.426	29.270	29.291	29.298	29.308	29.357	29.466	29.254	29.386
Harrisville	N. E.	29.287 2	29.312	29.285	29.270	29.246	[b]29.415	29.261	29.281	29.285	29.289	29.340	29.452	29.242	29.376
*Grand Haven**	W.	29.339 14	29.328	29.315	29.325	29.245	29.355	29.272	29.295	29.298	29.297	29.360	29.474	29.280	29.415
Reed City	W.		††	[b]28.815	28.852	28.822	[b]28.963	28.830	[b]28.841						
Port Austin	B. & E.		‡‡	[b]29.339	[f]29.354	29.269	29.437	[c]29.279	[d]29.305	[a]29.305	[g]29.333	[b]29.376	[b]29.476		
*Port Huron**	B. & E.	29.323 5	29.322	29.312	29.344	29.244	29.386	29.163	29.293	29.293	29.308	29.379	29.475	29.270	29.399
Thornville	B. & E.	28.957 7	28.937	28.904	28.936	28.847	28.993	28.869	28.904	28.913	28.925	28.991	29.084	28.887	28.993
Agricultural College*	C.	29.088 5	29.089	29.061	29.093	29.000	29.113	29.023	29.055	29.051	29.049	29.135	29.253	29.061	29.173
Ionia	C.		§§	29.127	[e]29.245	29.149	29.245			29.182	29.144	29.213	29.321	29.122	29.236
Lansing, S. B. of H.	C.	29.041 5	29.075	29.047	29.076	28.994	29.116	29.015	29.045	29.043	29.052	29.118	29.224	29.030	29.138
Swartz Creek	C.	29.157 2	29.166	29.147	29.171	29.095	29.214	29.101	29.126	29.127	29.119	29.211	29.318	29.119	29.239
Ann Arbor	S. C.	29.035 6	29.024	28.995	[d]29.039	28.938	29.063	28.948	28.988	28.986	[b]29.001	29.076	29.171	28.985	[a]29.092
Kalamazoo*	S. C.	29.036 10	28.907	28.910	28.947	28.848	28.960	28.871	28.883	28.854	28.858	28.921	29.022	28.845	28.965
Marshall	S. C.	29.023 3	29.026	29.005	29.032	28.936	29.057	28.969	28.986	28.991	29.011	29.073	29.165	28.983	29.105
Birmingham	S. E.		¶¶	[b]29.123	[d]29.151	29.076	[b]29.191	29.087	[b]29.086				[d]29.282	[c]29.070	[c]29.188
*Detroit**	S. E.	29.318 14	29.314	29.294	29.333	29.229	29.352	29.235	29.295	29.262	29.280	29.361	29.460	29.274	29.393

NOTE.—Computations of monthly averages for the year 1886 were furnished by the observers at Marquette, Escanaba, Mackinaw City, Alpena, Grand Haven, Port Huron, Detroit, and Ann Arbor. The remainder of the computations were made at the office of the State Board of Health.

* For stations marked thus * a correction has been made for instrumental error, as follows: For Marquette, .001 added for Jan., Feb., and Mar.; for April, .016 added; for May to Dec., .003 subtracted; for Escanaba, .017 added; for Mackinaw City, .008 added Jan. to Sept.; for Oct. .011 subtracted; for Nov. and Dec. .006 added; for Alpena, .006 added; for Grand Haven, .002 added for Jan. to April, and for May to Dec., .013 added; for Port Huron, .011 added for months Jan. to July, inclusive, and for Aug. to Dec., .005 added; for Detroit, .017 added; for Agricultural College, .013 subtracted; for Kalamazoo, .18 subtracted. For other stations the instrumental error of barometer is not known.

† At stations of the U. S. Signal Service for the year 1886, the observations were made at 7 A. M., 3 P. M., and 11 P.M., 75th meridian time. The corresponding local time for each of these stations is stated in the star (*) foot note to Table I., page 47.

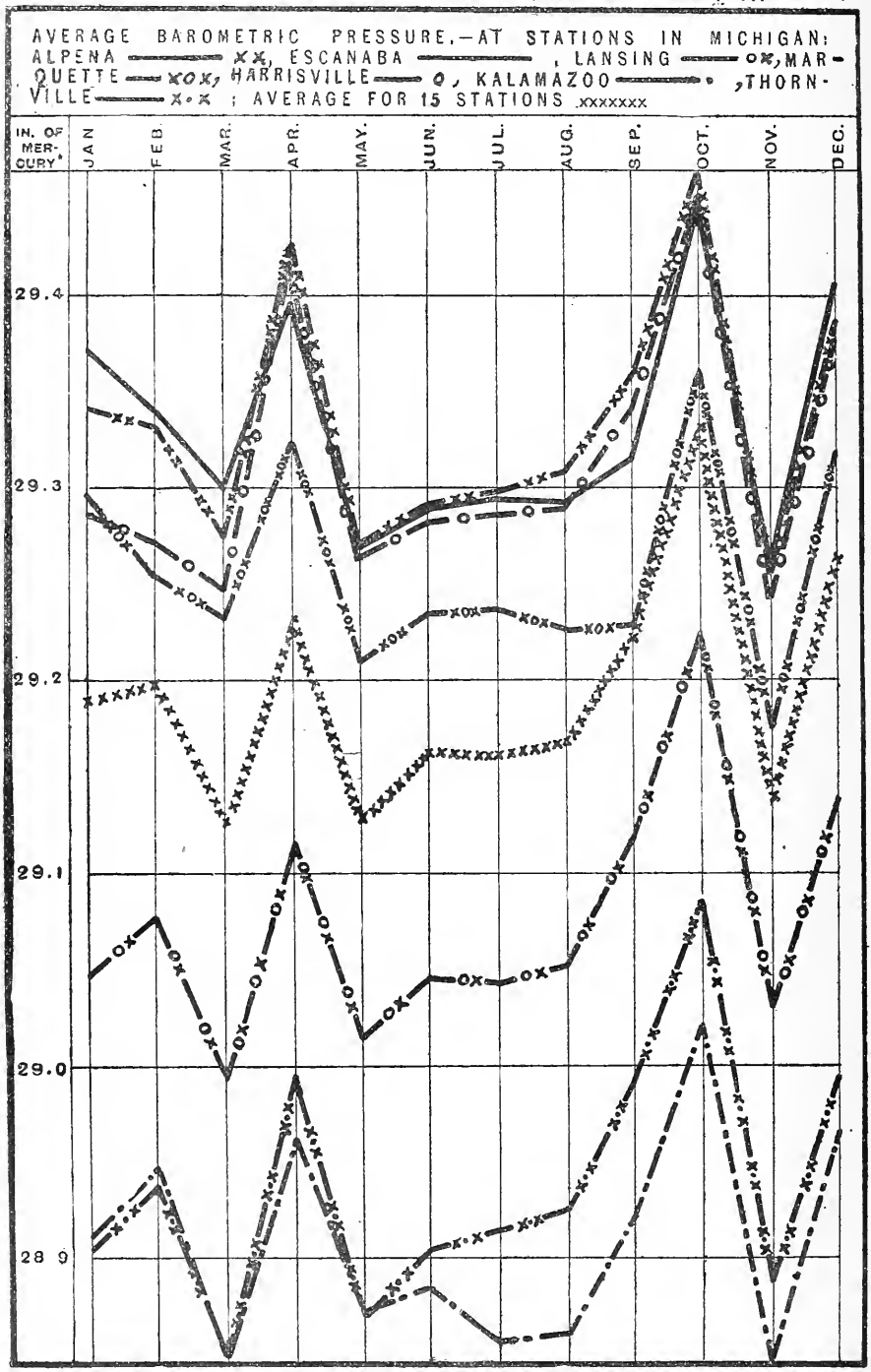
‡ The names of observers, their places of observation, and the counties in which these places are situated, are stated in Exhibit I, page 30. The full names of divisions and the counties in each division, are stated in Exhibit I, in a paper which follows, on weekly reports of sickness.

§ Numbers in this column state the average annual atmospheric pressure for a period of years ending in each case with Dec. 31, 1886. The small figures at the right of the numbers which state the average, denote the number of years included in the average. ¶ Not including Manistique and Gulliver Lake, Reed City, Ionia, Swartz Creek, Kalamazoo, Birmingham, and Port Austin.

‖ This line is an average for 15 stations. It does not include Port Austin, Manistique and Gulliver Lake, Reed City, Ionia, Swartz Creek, and Birmingham. Green's standard barometer was used at all the 15 stations except Kalamazoo for 1886. The barometer at Kalamazoo was manufactured by J. Foster, Cincinnati, Ohio. ** The average for 8 months in 1886 is 29.324. †† The average for 6 months is 28.854. ‡‡ For 10 months, 29.347. §§ For 10 months, 29.198. ¶¶ For 9 months, 29.139. [a] For 30 days. [b] For 29 days. [c] For 28 days. [d] For 27 days. [e] For 26 days. [f] For 25 days. [g] For 24 days. [h] For 23 days. [i] For 19 days. The lines for 7 stations in this Table are graphically represented in Diagram XV., page 104.

A The observations compiled in this line were made at Manistique until March 1, and at Gulliver Lake, by the same observer with the same instruments, for Aug. to Dec., inclusive. Gulliver Lake is about 12 miles east from Manistique.

DIAGRAM XV.—ATMOSPHERIC PRESSURE, BY MONTHS, IN 1886.



[1]SCALE ONE TENTH INCH OF MERCURY TO .86 IN. VERTICALLY.

H. B. T. DEL. DES. BY H. B. B.

THE TIME OF GREATEST PREVALENCE OF EACH DISEASE.

CONTRIBUTIONS TO THE STUDY OF THE CAUSES OF SICKNESS.

A STATISTICAL REPORT BASED ON WEEKLY REPORTS OF SICKNESS IN MICHIGAN DURING THE YEAR 1886, AND PRECEDING YEARS.

BY THE SECRETARY OF THE STATE BOARD OF HEALTH.

This paper is the tenth in a series of articles upon the same general subject, begun in the latter part of 1876. It presents a summary of the compilation of weekly reports of sickness in Michigan in 1886. It includes a series of diagrams or graphic illustrations which show by months in 1886 the rise and fall of twenty-seven of the most prominent diseases in Michigan.

Propositions are stated as to the relations of specified meteorological conditions, and diseases are mentioned under these propositions in such manner as to suggest one method of studying some of the facts brought out in the compilation.

Tables are given showing the per cent of the weekly *reports* which stated the presence of the various diseases, first (in Exhibit IV.), for each of the years 1877–1886, and an average for the entire period; and secondly (in Exhibit IV. continued), by months, in the year 1886, in each of the years 1884–5, and the average for the period of years 1877–86, the diseases being arranged in the order of their greatest reported prevalence in 1886, to facilitate a comparison with the prevalence of the same diseases in previous years, and in corresponding months in previous years.

The per cent of *observers* stating the presence of each of the diseases is given in Table 1, for the year 1886, and, for comparison, for each of the years 1877–1886, and, in Table 1 continued, for the months in the year 1886, and, for comparison by months in each of the years 1883, 4 and 5, and the average for the period 1877–86.

Comparing Table 1 with Exhibit IV., we see the correspondence in the two lines of evidence,—that of the "prevalence" of the diseases as shown by the per cent of *reports*, and the "area of prevalence" as shown by the per cent of *observers*, the diseases following each other in a somewhat similar order from highest to lowest—the diseases being arranged in the table, as in the exhibit, in the order of their greatest reported prevalence in 1886.

One of the objects of this compilation is to learn the time of the greatest and of the least prevalence of the more important diseases in the State, and to note the connection of this prevalence with each of the meteorological conditions in the State. Casual observation shows that certain diseases are much more prevalent in the hot months, while certain other diseases are

much more prevalent in the cold months. The relation between these diseases and the atmospheric temperature is well marked, but accurate statistics are needed to show just what that relation is. We find, also, that other meteorological conditions than atmospheric temperature have a marked effect upon many of the diseases, apparently diminishing the effect of temperature in some instances, increasing its effect in other instances. For this reason the State Board of Health undertakes by a compilation of the weekly reports of sickness in connection with the various meteorological conditions, to learn what causal relations exist between the humidity of the air, the ozone, the velocity of the wind, the atmospheric pressure, etc., and the increased or diminished prevalence of diseases in certain months as compared with other months in the same year, or with the same months in other years or series of years.

Since 1876, when this system of "weekly reports of diseases" was begun, an important work has been accomplished in learning the time of the greatest prevalence of each of several of the most important diseases, and consequently the time of greatest danger from each such disease in the State considered as a unit. To facilitate the study of the causes of sickness and deaths the State is divided into eleven geographical divisions, a list of which, and the counties embraced in each, appear in Exhibit I., page 111. From some of these divisions sufficient data are not yet received to make the study of the comparative prevalence of diseases in different parts of the State practicable. The number of reports from localities in the newer parts of the State is increasing, however, and a comparison of sickness by localities may become practicable in the near future.

PHYSICIAN'S WEEKLY REPORTS OF SICKNESS.

Weekly reports are now received concerning twenty-seven diseases, the names of which are printed on the blank postal used for the weekly report, and concerning these twenty-seven diseases a positive report is made each week by many of the leading physicians in Michigan.

Great credit is due the busy medical practitioners in Michigan who forward these reports of sickness. Some of them have made the reports regularly since this plan was adopted in 1876. The service is, as a rule, without compensation, possibly a few health officers may have slight pay from their local boards of health. No other class of persons, however, has knowledge of the facts that are necessary in the compilation of health statistics; and it is greatly to the credit of physicians that they are so willing to coöperate in every effort made to advance the public health.

PLAN OF THE WEEKLY CARD-REPORTS.

The number of observers has slightly increased during the year. The plan of the weekly reports remains the same as last year. Observers now report only the diseases under their own personal observation. Previous to the year 1885, some of the observers reported such diseases as they believed to be present in their locality, even though not under their own observation. The change in method of making the reports may account partially for the apparent decrease in sickness in 1886, when compared with the average for the ten years, 1877–86. Details of the method of securing and the plan of marking these reports may be thus stated:—

The blanks for the weekly reports are printed on postal cards, which are supplied to the observers of diseases. Blank record books, in which to preserve copies of the reports, remarks, etc., are also supplied to these observers, to be retained by them. The reports are forwarded weekly to the Secretary of the State Board of Health, at Lansing.

The plan of making the report is as follows: Each observer is requested to mark the disease of which there was the greatest number of cases under his observation during the week for which the report is made, 1; that of which there was the next greatest number of cases, 2; the next, 3; and so on, applying *consecutive* numbers to the diseases reported present; but marking with the *same* figure all diseases of which there is the same number of cases; to write 0 opposite each disease mentioned of which there was no case; to apply these numbers without regard to the severity of the cases; to include all cases, without regard to when they were taken sick, so long as they are actually sick with the given disease; to include all cases "under the observation" of the observer. A blank is left on the card for the convenience of those observers who prefer to state the number of cases rather than the order of prevalence by the foregoing method.

To illustrate the method of making the reports, the following copy of one of the blanks now in use is given, correctly marked, in the "prevalence" column, for the number of cases stated on the right-hand margin. It should be remembered that the numbers in the "prevalence" column denote simply the relative order in which the several diseases appear to be prevalent, and do not denote a definite number of cases; so that a disease might one week be marked *4*, and the following week, with the same number of cases, be marked *1*. Names of diseases and figures printed in italics are not *printed* on the postal blanks, but are supposed to have been *written* on the report by the observer.

*Diseases in*_____[and vicinity?]

☞ PLEASE DATE.

*week ending Sat.*_____, *188*__

*No.*_____ ED 23.		Prevalence. Order. See a.	*Cases.*
	Brain, Inflammation of	*14*	*1*
	Bowels, Inflammation of	*12*	*3*
	Bronchitis	*11*	*4*
	Cerebro-spinal Meningitis	*0*	*0*
	Cholera Infantum	*8*	*9*
	Cholera Morbus	*10*	*6*
	Consumption, Pulmonary	*10*	*6*
	Croup, Membranous	*12*	*3*
	Diphtheria	*5*	*14*
	Diarrhea	*3*	*17*
	Dysentery	*8*	*9*
	Erysipelas	*13*	*2*
	Fever, Intermittent	*2*	*21*
	Fever, Remittent	*11*	*4*
	Fever, Typhoid (Enteric)	*0*	*0*
	Fever, Typho-malarial	*9*	*7*
	Influenza	*7*	*11*
	Kidney, Inflammation of	*14*	*1*
	Measles	*1*	*27*
	Neuralgia	*14*	*1*
	Pneumonia	*9*	*7*
	Puerperal Fever	*0*	*0*
	Rheumatism	*6*	*12*
	Scarlatina	*4*	*16*
	Small-pox	*0*	*0*
	Tonsilitis	*11*	*4*
	Whooping-cough	*0*	*0*
	Mumps	*6*	*12*
	Dyspepsia	*11*	*4*

a. Please mark the disease of which there is the greatest number of cases, 1; the disease having next greatest number of cases, 2; the next, 3; and so on for each disease, giving the same figures opposite diseases having the same number of cases. Write 0 opposite each disease of which there is no case under your observation. [For full statement of plan, see second, third, and fourth pages of record-book cover.] A blank indicates that the item has been overlooked.

Please mail this, ☞ signed and dated, ☜ as soon as convenient after close of week specified.

☞ This report is of diseases UNDER YOUR OBSERVATION; if it includes a contagious disease, please mention, on the bottom or margin of this card, the township, city, or village in which the disease is.

_____, *M. D.*

BULLETINS OF HEALTH IN MICHIGAN.

During the year 1886 the issue of weekly and monthly bulletins of "Health in Michigan" has been continued. The weekly bulletin is compiled from the physicians' weekly reports from all parts of the State. It is designed to give, each week, information to the public concerning the diseases which cause most sickness in the State, the relative amount of sickness compared with the corresponding week in previous years, and compared with the preceding week—thus showing any sudden increase or decrease which may have occurred in the prevalence of any disease, together with a similar comparison of the various meteorological conditions; also, a list of the localities in which each of the dangerous communicable diseases are reported present. A copy of this bulletin has been sent to such editors as have expressed a desire to have it for use, entire or in part in their papers. About thirty copies are now used for this purpose each week. The monthly bulletin is similar in character to the weekly bulletin. It is issued as soon as possible after the close of each month, and it is sent to the sanitary and medical journals which are received as exchanges by the library of the State Board of Health. About seventy copies are thus used at the present time.

As a rule, about one-half of the card reports reach the office of the State Board of Health in time for compilation in the weekly bulletin, and the monthly bulletins are compiled from the information used in the weekly bulletin. A circular letter has been sent to a number of the observers of diseases, urging them to greater promptness in forwarding their weekly reports of sickness. It has been thought that the more promptly reports are forwarded after the facts have been observed, the greater the probability of their perfect accuracy, because there is then little chance of facts having been forgotten. It is found, however, that the statements made in the monthly bulletins are corroborated by the information obtained after the close of the year, in the compilation of the whole number of reports for the corresponding months of the year. This is probably because records are kept, by the observers, in the pamphlet record-books supplied by the State Board of Health, the cards which are received at this office too late for compilation in the weekly bulletin being correctly made up from these record books.

COMPILATION OF THE WEEKLY REPORTS.

The reports from each locality are compiled by months. The average of the numbers stating the order of prevalence of the several diseases for the month is considered an indication of the actual order of prevalence of the diseases for that time. There is also found for each locality what per cent of the reports state the presence of each disease for the given month. This per cent of reports for a single locality indicates what part of the month the disease was present in that locality. It may also be called the per cent of weeks the disease was present. These first results of the compilation are stated in Table 3, which, on account of the space required, has not been printed in the Reports since that of 1882, but is preserved in the office of the State Board for reference and study.

A combination of the statements for localities in Table 3 is made by months for the State, so far as it is represented by the localities from which reports are received showing: (1) What per cent of the observers reported each

disease each month; (2) for the localities at which a given disease was reported, an average of the per cent of weeks it was reported at those localities; (3) what per cent of all the reports received for the month stated the presence of each disease; (4) an average of the numbers denoting the order of prevalence of each disease at the localities at which it was reported present during the month.

THE PREVALENCE OF THE SEVERAL DISEASES IN 1886.

By noting the per cent of all the reports received for a given time which stated the presence of each disease, the relative prevalence of the several diseases may be readily seen. This per cent has been computed for each disease, by months for the year 1886. It is thus stated in Exhibit II., page 112, which also states the per cent for each disease for each of the preceding nine years. What per cent of the reports stated the presence of each disease by months in 1886, is graphically represented in Diagrams 1–5, on page 113, and following pages.

For eighteen diseases a comparison has been made of the amount of sickness in 1886 (as indicated by the proportion of reports stating the presence of the disease) with the average amount for a period of 10 years. These comparisons are shown in Exhibits XI., XIII., XVIII., and XX. A comparison is made in Table I, page 121, between the number of observers reporting the tabulated diseases present in each of the years 1877–1886, and by months in a part of those years. In Exhibit IV., on pages 115, 116, and 117, the per cent of reports stating the presence of each of the twenty-seven tabulated diseases for the the years 1877–1886, and by months in a part of those years is given. In Table I, and in Exhibit IV., the diseases are arranged in the order of the greatest per cents for 1886, the highest being placed first.

A study of the reported sickness from twenty-seven diseases, in connection with meteorological conditions by months in 1886, is made in Exhibit X., and following exhibits. By arranging months in order of greatest prevalence of the disease under consideration, noting whether it is more or less prevalent than the average for the year, and noting what were the meteorological conditions for the same months as compared with the average for the year, relations and comparisons are grouped for convenient comparison. A summary of one line of the evidence presented by these exhibits is given in Exhibits XXIV. and XXV.

In Exhibits VI and VII., on following pages, the leading diseases are arranged in order according to the amount of sickness reported from them in 1886, those from which there was most sickness reported being placed first. In these exhibits the diseases are arranged with reference to the per cent of reports taken in connection with the average order of prevalence.

The comparison with former years is facilitated by reference to Exhibit II., page 112, Table I, pages 121, 122, and 123, Exhibit IV., pages 115, 116 and 117, and Exhibits XI., XIII., XVIII., and XX.

Exhibit IV., on pages 115, 116, and 117, is continued for 1886. In it the diseases are arranged in order of the greatest per cent of reports stating the presence of the diseases in 1886, the highest per cent being placed first in the line. It is similar in form to Table I, pages 121-3, which shows the per cent of

observers by whom diseases were reported present. It affords a means of comparing the diseases showing greatest prevalence with those showing greatest area of prevalence or widest distribution. It affords also a means for the comparison of per cent of reports in 1886 with the average per cent of reports in the ten years 1877–1886, both for the year and by months, also by months in 1886 with several of the years previous to 1886.

DISEASES FROM WHICH THERE WAS A MARKED INCREASE OR LESSENED PREVALENCE IN MICHIGAN IN 1886.

By referring to Exhibits XI., XIII., XVIII., and XX., it will be seen that all the prominent diseases except tonsilitis, neuralgia, whooping-cough, rheumatism, diarrhea and cholera infantum have shown a marked decrease in 1886 compared with the average in the ten years 1877–86. The diseases in which the decrease appears most marked are intermittent fever, remittent fever, pneumonia, and consumption of lungs. The decrease was also well marked in measles for the year and for the first eight months of the year when compared with the average in the ten years, but during the last four months of the year the average came nearly up to or equaled the average in the ten years. In these exhibits the per cent of reports by months in 1886 is placed directly under the per cents for the corresponding months in 1885. A comparison between the corresponding months in the two years is thus made possible, and the comparison of the months in 1886 with the averages for the months in the series of years preceding is made easy by placing the differences, greater or less, in separate lines.

A part of the lessened prevalence of some of the prominent diseases may be due to the change in the method of reporting sickness, referred to in last paragraph on page 106.

EXHIBIT I.—*Eleven Geographical Divisions of the State, formed for the purpose of facilitating the study of Causes of Sickness and of Deaths, with a list of Counties included in each Division.*

1.–Upper Peninsular.	2.–North-western.	3.–Northern.	4.–North-eastern.	5.–Western.	6.–Northern-Central.	7.–Bay and Eastern.	8.–Central.	9.–South-western.	10.–Southern-Central.	11.–South-eastern.
Alger.	Benzie.	Antrim.	Alcona.	Kent.	Clare.	Arenac.	Barry.	Allegan.	Branch.	Macomb
Baraga.	Gr. Traverse.	Charlevoix.	Alpena.	Lake.	Gladwin.	Bay.	Clinton.	Berrien.	Calhoun.	Monroe.
Chippewa.	Leelanaw.	Cheboygan.	Iosco.	Mason.	Isabella.	Huron.	Eaton.	Cass.	Hillsdale.	Oakland.
Delta.	Manistee.	Crawford.	Montmorency.	Muskegon.	Mecosta.	Lapeer.	Genesee.	Van Buren.	Jackson.	Wayne.
Gogebic.	Manitou.	Emmet.	Ogemaw.	Newaygo.	Midland.	Saginaw.	Gratiot.		Kalamazoo.	
Houghton.	Wexford.	Kalkaska.	Oscoda.	Oceana.	Roscommon.	Sanilac.	Ingham.		Lenawee.	
Iron.		Otsego.	Presque Isle.	Ottawa.	Missaukee.	St. Clair.	Ionia.		St. Joseph.	
Isle Royal					Osceola.	Tuscola.	Livingston.		Washtenaw.	
Keweenaw.							Montcalm.			
Luce.							Shiawassee.			
Mackinac.										
Marquette.										
Menominee.										
Ontonagon.										
Schoolcraft.										

EXHIBIT II.—*Stating for each of 27 Diseases for the ten Years ending Saturday, January 1, 1887, for each of those Years, and by Months of the Year 1886, on what Per Cent of the Reports Received the Disease was stated to be Present.—Compiled from Weekly Reports by Health Officers of Cities and Villages, by Regular Correspondents of the State Board of Health, and by other Physicians.**

Diseases.	What Per Cent of the Reports Received Stated the Presence of the Disease.																						
	Years.										Months, 1886.												
	Av., 1877-86.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average†	30	28	30	33	32	33	30	30	29	26	26	26	26	28	27	26	23	26	27	28	25	25	25
Brain, inflam of	6	.....	.....	.....	6	5	5	6	7	6	5	7	5	6	7	5	7	6	6	4	4	4	6
Bowels, inflam. of	15	.....	.....	.....	12	14	13	16	17	17	17	16	15	15	13	19	18	20	21	20	17	12	16
Bronchitis	61	55	64	64	64	62	65	66	61	56	56	71	69	71	65	57	45	40	37	41	51	61	65
Cer.-spi. Men	5	3	2	2	2	9	6	5	7	6	4	4	4	7	4	3	2	4	2	2	4	3	4
Cholera Infantum	13	11	11	14	14	18	12	14	15	11	14	1	1	2	2	5	10	29	47	42	17	5	2
Cholera Morbus	19	15	14	19	20	26	17	18	22	17	17	3	2	3	5	8	12	41	54	40	13	6	5
Consumption, Pul.	64	52	71	70	68	71	66	61	63	58	55	61	58	60	61	60	55	51	52	48	51	55	54
Croup, Mem	6	6	7	7	6	9	7	6	6	5	5	7	6	4	3	4	4	2	3	5	8	9	8
Diphtheria	22	19	23	29	27	34	25	17	15	14	13	18	14	11	12	12	9	10	10	10	17	18	15
Diarrhœa	47	41	41	48	47	52	48	49	52	46	45	27	31	25	31	38	40	66	82	81	51	36	27
Dysentery	19	21	19	18	18	23	17	21	23	15	17	5	8	7	7	10	10	24	44	43	25	12	7
Erysipelas	23	20	21	25	25	23	22	25	26	24	23	25	25	26	31	28	24	20	18	18	21	20	20
Fever, Intermit.	72	75	82	82	82	82	71	69	65	59	54	47	49	50	61	57	61	61	60	58	57	48	41
Fever, Remittent	48	52	58	57	56	54	48	41	44	36	34	33	29	34	34	35	36	36	36	36	33	34	27
Fever, Typhoid (Enterie)	12	14	10	12	14	18	14	11	12	8	8	6	3	4	3	5	4	5	13	16	16	13	10
Fever, Typho-Malarial	22	26	24	22	24	29	24	18	20	16	16	10	9	12	9	11	10	14	18	27	25	24	15
Influenza	40	41	44	45	42	35	40	43	41	34	35	44	51	62	54	35	26	14	10	21	27	36	42
Kidney, Inflam of	22	.....	.....	.....	.....	.....	.....	.....	26	21	20	21	19	21	25	24	19	19	18	15	18	17	32
Measles	13	7	5	12	19	26	11	24	10	5	6	4	5	6	5	11	7	4	4	4	4	5	7
Neuralgia	66	.....	.....	59	64	65	68	69	70	68	67	69	69	74	74	71	63	63	60	61	63	67	73
Pneumonia	37	40	41	41	42	41	39	38	29	27	27	37	46	52	41	29	19	11	10	12	13	22	37
Puerperal Fever	5	4	3	3	3	5	7	7	7	6	5	6	5	6	7	5	5	4	5	4	6	4	5
Rheumatism	69	60	68	72	71	71	68	68	70	68	70	68	71	78	76	74	70	63	62	65	69	72	73
Scarlatina	18	21	25	23	15	19	18	19	16	12	11	11	12	17	12	13	13	7	6	7	12	9	13
Small-pox	1.1	4	0.2	0.4	0.4	2	3	0.3	0.1	0.2	0.4	0	0	0	0	0	0.4	1	1	0.5	0.9	0 7	0.4
Tonsilitis	39	.....	.....	45	49	48	48	50	50	50	49	62	63	63	54	44	39	32	31	39	44	52	61
Whooping-cough	20	21	21	23	32	16	17	15	23	14	20	16	17	17	15	23	23	23	26	24	20	19	14
No. of reports rec'd	4,171	3,320	3,221	3,755	3,991	3,567	4,745	4,458	3,957	5,108	5,583	448	465	530	368	398	508	446	470	567	446	433	504

Statements in this exhibit for months in 1886 are graphically represented in Diagrams 1, 2, 3, 4, 5, opposite this page and on following pages.

* For 1886 the names of observers are stated in Exhibit V., on following, pages.

† This line is an average for such of the tabulated diseases as were reported present in the given month or year.

DIAGRAM 1 —WEEKLY REPORTS OF SICKNESS IN MICHIGAN, IN 1886.

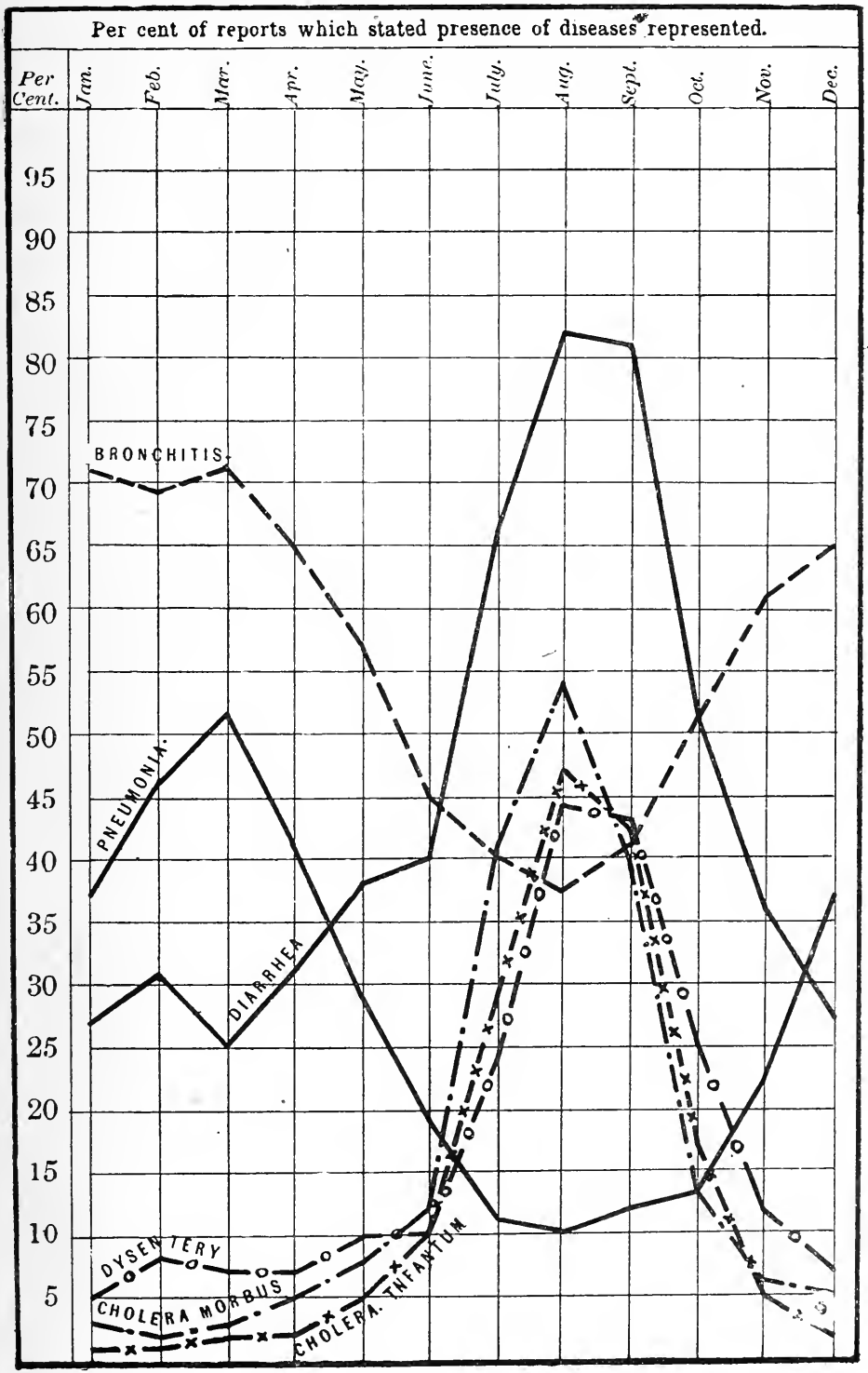


EXHIBIT III.—*Stating, by Months of the Year ending Saturday, January 1, 1887, for the State, and for each of the Eleven Geographical Divisions of Michigan from which Weekly Reports of Diseases were received, the Number of Observers from whom the Reports were received; the Number of Reports received; the day on which, for the purposes of this compilation, each Month is made to end; and the Number of Weeks thus included in each Month.*

Months, 1886.	Months and Year end Saturday.	Number of Weeks.	State.		Divisions of the State.*																					
					1. Upper Peninsular*		2. Northwestern.*		3. Northern.*		4. Northeastern.*		5. Western.*		6. Northern Central.*		7. Bay and Eastern.*		8. Central.*		9. Southwestern.*		10. Southern Central.*		11. Southeastern.*	
			Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†	Observers.‡	Reports.†
Year 1886‡	Jan. 1, 1887	52	169	5,583	6	156	3	75	6	161	4	157	18	553	9	200	23	846	31	1,005	16	504	30	1,111	23	815
Av. per month.			113	465	3	13	2	6	3	13	3	13	11	46	4	17	17	71	21	84	10	42	22	93	16	68
January	Jan. 30	4	119	448	3	11	1	4	4	16	3	12	11	42	2	8	19	64	23	89	11	44	24	90	18	68
February	Feb. 27	4	120	465	3	12	1	4	4	16	3	12	11	42	2	8	19	69	24	95	11	43	24	94	18	70
March	April 3	5	122	530	3	14	1	5	4	18	3	14	11	52	2	10	17	76	22	103	10	49	23	113	16	76
April	May 1	4	100	368	3	10	1	4	2	8	3	12	10	35	1	4	15	57	19	64	10	37	21	83	15	54
May	May 29	4	105	398	3	12	1	4	2	8	3	12	9	33	4	15	17	63	19	69	10	38	22	84	15	60
June	July 3	5	109	508	3	12	2	8	3	14	3	14	9	42	4	18	16	76	21	95	11	48	22	107	15	74
July	July 31	4	118	446	3	11	2	7	4	16	3	11	11	41	5	17	18	69	22	86	10	39	24	86	16	63
August	Aug. 28	4	123	470	3	12	2	6	4	14	3	10	13	50	7	25	18	71	21	82	11	43	23	86	18	71
September	Oct. 2	5	118	567	3	14	2	10	3	14	3	14	13	63	7	34	18	87	18	87	11	50	22	104	18	90
October	Oct. 30	4	118	446	3	11	2	6	3	12	4	15	13	51	5	19	18	68	21	79	9	33	22	87	18	65
November	Nov. 27	4	112	433	5	18	2	7	3	10	4	16	12	48	5	18	16	64	20	77	9	35	21	82	15	58
December	Jan. 1, 1887	5	105	504	4	19	2	10	3	15	3	15	11	54	5	24	17	82	17	79	9	45	20	95	14	66

* For counties in each division, see Exhibit I., page 111. † From some of the observers reports were not received for every week, so that the number of reports received does not equal the number of observers multiplied by the number of weeks in the given month or in the year.

‡ In some localities there were more observers than one. The whole number of localities from which reports were received was 143; the average number per month was 104. The names of observers and number of cards received from each observer for each month and for the year is stated in Exhibit V., pages 118-120.

EXHIBIT IV.—*Stating for each of 27 Diseases for the Ten Years ending Saturday, January 1, 1887, and for each of those years, on what Per Cent of the Reports received the diseases were stated to be present. Compiled from Weekly Reports by Health Officers of Cities and Villages and by Regular Correspondents of the State Board of Health.* (Continued for each month of several of the above mentioned years on pages 116 and 117.)*

Line Number.	Diseases.	What Per Cent of Reports Stated the Presence of the Disease.									
		Average 1877-86.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.	1878.	1877.
	Average Disease†	30	26	26	29	30	30	33	32	33	30	28
1	Rheumatism	69	70	68	70	68	68	71	71	72	68	60
2	Neuralgia‡	66	67	68	70	69	68	65	64	59	.....	.....
3	Bronchitis	61	56	56	61	66	65	62	64	64	64	55
4	Consumption, Pulmon'ry‡	64	55	58	63	61	66	71	68	70	71	52
5	Intermittent Fever	72	54	59	65	69	71	82	82	82	82	75
6	Tonsilitis‡	49	49	50	50	50	48	48	49	45	.....	.....
7	Diarrhea	47	45	46	52	49	48	52	47	48	41	41
8	Influenza	40	35	34	41	43	40	35	42	45	44	41
9	Remittent Fever‡	48	34	36	44	41	48	54	56	57	58	52
10	Pneumonia	37	27	27	29	38	39	41	42	41	41	40
11	Erysipelas	23	23	24	26	25	22	23	25	25	21	20
12	Whooping-cough	20	20	14	23	15	17	16	32	23	21	21
13	Inflammation of Kidney‡	22	20	21	26	.....	.....	.....	.....	.....	.....	.....
14	Dysentery	19	17	15	23	21	17	23	18	18	19	21
15	Inflammation of Bowels‡	15	17	17	17	16	13	14	12	.....	.....	.....
16	Cholera Morbus	19	17	17	22	18	17	26	20	19	14	15
17	Typho-malarial Fever‡	22	16	16	20	18	24	29	24	22	24	26
18	Cholera Infantum	13	14	11	15	14	12	18	14	14	11	11
19	Diphtheria	22	13	14	15	17	25	34	27	29	23	19
20	Scarlatina	18	11	12	16	19	18	19	15	23	25	21
21	Typhoid Fever (Enteric)	12	8	8	12	11	14	18	14	12	10	14
22	Measles	13	6	5	10	24	11	26	19	12	5	7
23	Inflammation of Brain‡	6	5	6	7	6	5	5	6	.....	.....	.....
24	Membranous Croup	6	5	5	6	6	7	9	6	7	7	6
25	Puerperal Fever	5	5	6	7	7	7	5	3	3	3	4
26	Cerebro-spinal Meningitis	5	4	6	7	5	6	9	2	2	2	3
27	Small-pox	1	0.4	0.2	0.1	0.3	3	2	0.4	0.4	0.2	4
	No. of reports received	4,171	5,583	5,108	3,957	4,458	4,745	3,567	3,991	3,755	3,221	3,320

* For 1886 the number of observers, reports, weeks in each month, etc., are stated in the first five columns of Exhibit III., page 114, the names of the observers and the number of the reports received from each are stated in Exhibit V., pages 118-120.

† The numbers opposite the names of the diseases do not state what per cent of the whole number of reports for the year stated the disease to be present at some time during the year, but state (on an average for twelve months of the year) what per cent of reports for the several months stated the disease to be present in those months. The column for each year is thus a statement for an average month of that year. On the two following pages of this table, however, the columns for each month state what per cent of the reports for that month (the number of which is stated at the foot of the column) stated the given disease to be present in that month.

‡ Consumption, remittent fever, and typho-malarial fever were not printed on the first blanks used in making weekly reports (beginning with the month of September, 1876); neuralgia and tonsilitis were not printed on any blanks used prior to October, 1878, and not on all used for several months after that date; inflammation of brain and inflammation of bowels were not printed on any blanks used prior to July, 1879, and not on all used for several months after that date; inflammation of kidney was not printed on any of the cards used prior to October, 1883, and not on all used for several months after that date; hence it is probable that these diseases were not so fully reported at first as were the other diseases.

EXHIBIT IV.—CONTINUED.—*Stating for each of 27 Diseases by Months, on what Per 1877–1886, Also the Average*

What Per Cent of the Reports received Stated Presence of the Disease.

Line Number.	January.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	February.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	March.* Diseases.	Av. '77-'86.	1886.	1885.	1884.
	Average Disease.†	30	26	29	29	Average Disease.†	31	26	29	29	Average Disease.†	31	28	30	30
1	Bronchitis	77	71	73	71	Rheumatism	73	71	76	67	Rheumatism	75	78	82	70
2	Neuralgia‡	69	69	79	69	Neuralgia‡	71	69	79	73	Neuralgia‡	74	74	77	74
3	Rheumatism	73	68	73	65	Bronchitis	77	69	74	71	Bronchitis	77	71	76	71
4	Tonsilitis‡	60	62	63	53	Tonsilitis‡	62	63	58	59	Tonsilitis‡	61	63	61	56
5	Consumpt'n, Pul.‡	64	61	60	56	Consump., Pul.‡	66	58	68	61	Influenza	59	62	52	50
6	Intermittent F	58	47	51	56	Influenza	60	51	60	51	Consump., Pul.‡	66	60	71	66
7	Influenza‡	55	44	58	55	Intermittent F	60	49	52	56	Pneumonia	61	52	60	43
8	Pneumonia	58	37	50	54	Pneumonia	63	46	58	49	Intermittent F	63	50	51	57
9	Remittent F‡	40	33	33	38	Diarrhea	28	31	31	27	Remittent F‡	41	34	43	40
10	Diarrhea	27	27	26	28	Remittent F‡	39	29	32	40	Erysipelas	28	26	35	24
11	Erysipelas	27	25	32	23	Erysipelas	27	25	35	24	Diarrhea	29	25	35	26
12	Infl. of Kidney‡	25	21	26	28	Infl. of Kidney‡	26	19	27	31	Infl. of Kidney‡	25	21	24	29
13	Diphtheria	28	18	14	17	Whoop.-cough	20	17	16	21	Scarlet Fever	24	17	14	28
14	Whooping-cough	20	16	18	21	Infl. of Bowels‡	13	15	16	12	Whoop.-cough	20	17	20	20
15	Infl. of Bowels‡	13	16	14	12	Diphtheria	24	14	10	13	Infl. of Bowels‡	15	15	20	17
16	Scarlatina	22	11	16	19	Scarlet Fever	24	12	18	25	Typho-mal F‡	14	12	14	13
17	Typho-mal. F‡	18	10	15	14	Typho-mal. F‡	15	9	16	12	Diphtheria	21	11	11	16
18	Infl. of Brain‡	6	7	8	7	Dysentery	7	8	7	7	Dysentery	8	7	7	12
19	Membr. Croup	12	7	16	7	Mem. Croup	10	6	10	10	Cer.-spinal Men.‡	6	7	12	9
20	Typhoid Fever	11	6	11	10	Measles	13	5	7	16	Measles	16	6	10	14
21	Puerperal Fever	5	6	5	4	Infl. of Brain‡	6	5	7	7	Puerperal F	7	6	10	10
22	Dysentery	7	5	8	10	Puerperal F	5	5	5	9	Infl. of Brain‡	6	6	9	8
23	Measles	10	4	4	16	Cer.-spinal Men.	5	4	9	7	Typhoid Fever	7	4	5	8
24	Cer.-spinal Men.	4	4	8	4	Typhoid Fever	8	3	7	7	Mem. Croup	8	4	10	5
25	Cholera Morbus	4	3	3	5	Cholera Morbus	5	2	4	5	Cholera Morbus	6	3	8	9
26	Cholera Infantum	2	1	3	1	Cholera Infantum	1.5	1	1	3	Cholera Infantum	2	2	1	4
27	Small-pox	1.6	0	0	0	Small-pox	1.2	0	1	0	Small-pox	0.9	0	0.4	0
	Reports received.§	354	448	280	385	Reports received.§	321	465	274	306	Reports received.§	347	530	271	304

Line Number.	April.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	May.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	June.* Diseases.	Av. '77-'86.	1886.	1885.	1884.
	Average Disease.†	30	27	28	28	Average Disease.†	28	26	25	28	Average Disease.†	27	23	24	29
1	Rheumatism	75	76	79	75	Rheumatism	71	74	74	77	Rheumatism	68	70	71	73
2	Neuralgia‡	73	74	75	76	Neuralgia‡	67	71	67	74	Neuralgia‡	65	63	67	67
3	Bronchitis	71	65	73	65	Consump., Pul.‡	65	60	58	67	Intermittent F	80	61	68	72
4	Consumpt'n, Pul.‡	68	61	69	70	Bronchitis	61	57	56	59	Consump., Pul.‡	64	55	61	65
5	Intermittent F	72	61	57	65	Intermittent F	78	57	64	68	Bronchitis	53	45	52	56
6	Tonsilitis‡	53	54	53	53	Tonsilitis‡	47	44	50	52	Diarrhea	45	40	44	52
7	Influenza	53	54	41	49	Diarrhea	37	38	36	45	Tonsilitis‡	42	39	43	45
8	Pneumonia	54	41	50	39	Remittent F‡	47	35	33	40	Remittent F‡	48	36	35	43
9	Remittent F‡	44	34	38	42	Influenza	38	35	31	42	Influenza	28	26	23	30
10	Erysipelas	28	31	29	25	Pneumonia	39	29	31	24	Erysipelas	24	24	24	24
11	Diarrhea	32	31	23	38	Erysipelas	26	28	27	27	Whoop-cough	20	23	10	22
12	Infl. of Kidney‡	24	25	22	26	Infl. of Kidney‡	25	24	22	29	Infl. of Kidney‡	22	19	21	27
13	Whooping-cough	17	15	17	16	Whoop-cough	19	23	9	21	Pneumonia	25	19	19	18
14	Infl. of Bowels‡	13	13	17	11	Infl. of Bowels‡	13	19	18	12	Infl. of Bowels‡	16	18	18	18
15	Scarlatina	22	12	13	22	Scarlatina	20	13	13	25	Scarlatina	17	18	15	14
16	Diphtheria	20	12	16	12	Diphtheria	17	12	9	17	Cholera Morbus	18	12	18	26
17	Typho-mal. F‡	12	9	10	11	Typho-mal. F‡	12	11	11	12	Typho-mal. F‡	12	10	10	12
18	Puerperal Fever	5	7	8	6	Measles	26	11	9	17	Cholera Infantum	10	10	7	14
19	Dysentery	8	7	9	10	Dysentery	9	10	7	11	Dysentery	14	10	11	17
20	Infl. of Brain‡	7	7	11	6	Cholera Morbus	8	8	10	7	Diphtheria	15	9	12	13
21	Measles	21	5	10	14	Infl. of Brain‡	6	5	5	6	Measles	21	7	7	13
22	Cholera Morbus	6	5	7	6	Cholera Infantum	3	5	5	5	Infl. of Brain‡	6	7	7	8
23	Cer.-spinal Men.	7	4	8	10	Puerperal F	5	5	6	6	Puerperal F	5	5	5	7
24	Typhoid Fever	6	3	4	6	Typhoid Fever	5	5	3	5	Mem. Croup	4	4	3	4
25	Membr. Croup	7	3	6	4	Mem. Croup	5	4	3	5	Typhoid Fever	6	4	5	4
26	Cholera Infantum	2	2	2	6	Cer.-spinal Men.	6	3	6	6	Cer.-spinal Men.	5	2	5	6
27	Small-pox	1.6	0	0.3	0.3	Small-pox	2.4	0	1	1	Small-pox	1.9	0.4	1	0
	Reports received.§	303	368	314	321	Reports received.§	334	348	347	281	Reports received.§	336	508	399	301

* For 1886 the number of observers, reports, weeks in each month, etc., are stated in the first five columns of Exhibit III, page 114, the names of observers and the number of reports received from each are stated in Exhibit V., pages 118-120. † The numbers in this line are an average, not for all diseases represented, but only for those reported present in the given month. ‡ See foot-note with this mark on page 115. § The numbers in this line state how many reports were received for the month in the given year.

Cent of the Reports Received the Diseases were stated to be Present in the Years for the Ten Years, 1877-1886.

What Per Cent of the Reports Received Stated Presence of the Disease.

July.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	August.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	September.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	Line Number.
Average Disease.†	29	25	26	31	Average Disease.†	32	27	27	34	Average Disease.†	33	28	27	34	
Diarrhea	73	66	65	73	Diarrhea	86	82	77	88	Diarrhea	81	81	65	88	1
Rheumatism	62	63	63	67	Rheumatism	57	62	59	68	Rheumatism	61	65	60	67	2
Neuralgia‡	60	63	61	68	Intermittent F‡	81	60	65	73	Neuralgia‡	61	61	64	63	3
Intermittent F‡	82	61	67	76	Neuralgia‡	58	60	58	64	Intermittent F‡	81	58	65	73	4
Consump., Pul.‡	61	51	56	63	Cholera Morbus	57	54	47	52	Consump., Pul.‡	60	48	54	63	5
Cholera Morbus	47	41	40	44	Consump., Pul.‡	58	52	52	63	Dysentery	48	43	29	60	6
Bronchitis	43	40	44	49	Cholera Infant	48	47	35	43	Cholera Infantum	36	42	18	47	7
Remittent F‡	51	36	32	50	Dysentery	54	44	34	50	Bronchitis	48	41	45	50	8
Tonsilitis‡	33	32	38	38	Bronchitis	41	37	39	47	Cholera Morbus	39	40	26	51	9
Cholera Infantum	31	29	22	29	Remittent F‡	57	36	39	47	Tonsilitis‡	37	39	42	39	10
Dysentery	31	24	16	36	Tonsilitis	32	31	37	38	Remittent F‡	60	36	40	53	11
Whoop-cough	22	23	14	28	Whoop-cough	23	26	16	29	Typho-mal. F‡	40	27	24	33	12
Erysipelas	21	20	21	28	Infl. of Bowels‡	21	21	20	24	Whoop-cough	22	24	16	22	13
Infl. of Bowels‡	18	20	16	20	Erysipelas	19	18	16	28	Influenza	29	21	30	34	14
Infl. of Kidney‡	20	19	18	24	Infl. of Kidney‡	20	18	19	23	Infl. of Bowels‡	17	20	13	25	15
Typho-mal. F‡	16	14	10	14	Typho-mal. F‡	25	18	15	23	Erysipelas	17	18	17	24	16
Influenza	20	14	18	27	Typhoid Fever	13	13	6	14	Typhoid Fever	20	16	11	19	17
Pneumonia	16	11	11	16	Influenza	21	10	18	30	Infl. of Kidney‡	18	15	17	22	18
Diphtheria	15	10	14	8	Diphtheria	16	10	13	14	Pneumonia	17	12	12	10	19
Scarlatina	14	7	13	12	Pneumonia	13	10	10	11	Diphtheria	18	10	15	10	20
Infl. of Brain‡	6	6	6	8	Scarlatina	12	6	8	12	Scarlatina	13	7	7	9	21
Typhoid Fever	7	5	5	7	Infl. of Brain‡	7	6	6	9	Mem. Croup	4	5	3	5	22
Puerperal F	4	4	5	6	Puerperal F	5	5	5	8	Measles	5	4	2	4	23
Measles	14	4	8	5	Measles	7	4	2	4	Puerperal F	5	4	4	7	24
Cer.-spinal Men.	4	4	8	5	Mem. Croup	2.5	3	1	4	Infl. of Brain	6	4	5	8	25
Mem. Croup	2	2	2	4	Cer.-spinal Men.	4	2	6	9	Cer.-spinal Men.	4	2	6	7	26
Small-pox	1.5	1	0	0	Small-pox	0.7	1	0	0	Small-pox	0.4	0.5	0	0	27
Reports received.§	362	446	564	407	Reports received.§	373	470	485	315	Reports received.§	364	567	601	302	

October.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	November.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	December.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	Line Number.
Average Disease.†	31	25	26	33	Average Disease.†	30	25	26	30	Average Disease.†	29	25	26	29	
Rheumatism	67	69	64	67	Rheumatism	72	72	70	70	Neuralgia‡	70	73	73	73	1
Neuralgia‡	63	63	62	68	Neuralgia‡	68	67	67	73	Rheumatism	74	73	70	76	2
Intermittent F‡	79	57	60	72	Bronchitis	66	61	58	68	Bronchitis	71	65	64	70	3
Diarrhea	56	51	44	70	Consump., Pul.‡	64	55	56	60	Tonsilitis‡	60	61	60	57	4
Bronchitis	54	51	51	56	Tonsilitis‡	55	52	58	58	Consump., Pul.‡	63	54	56	58	5
Consump., Pul.‡	63	51	55	65	Intermittent F	70	48	55	61	Influenza	48	42	40	49	6
Tonsilitis‡	45	44	48	48	Influenza	41	36	37	41	Intermittent F	61	41	49	53	7
Remittent F‡	58	33	39	54	Diarrhea	36	36	33	46	Pneumonia	45	37	39	34	8
Influenza	33	27	31	37	Remittent F‡	48	34	38	43	Diarrhea	28	27	27	35	9
Typho-mal. F‡	43	25	25	39	Typho-mal. F‡	33	24	21	33	Remittent F‡	42	27	31	40	10
Dysentery	25	25	16	44	Pneumonia	33	22	22	29	Infl. of Kidney‡	23	22	20	27	11
Erysipelas	21	21	18	27	Erysipelas	22	20	26	28	Erysipelas	24	20	28	26	12
Whoop-cough	19	20	15	15	Whoop.-cough	20	19	14	14	Infl. of Bowels‡	14	16	17	16	13
Infl. of Kidney‡	22	18	21	26	Diphtheria	20	18	16	19	Diphtheria	28	15	17	20	14
Infl. of Bowels‡	15	17	17	17	Infl. of Kidney‡	20	17	19	25	Typho-mal. F‡	22	15	14	23	15
Cholera Infantum	14	17	8	22	Typhoid Fever	21	13	16	23	Whoop.-cough	19	14	13	17	16
Diphtheria	26	17	19	18	Infl. of Bowels‡	14	12	16	17	Scarlatina	18	13	11	15	17
Typhoid Fever	22	16	13	23	Dysentery	12	12	12	15	Typhoid Fever	15	10	8	13	18
Cholera Morbus	16	13	11	29	Scarlatina	17	9	11	10	Mem. Croup	10	8	5	10	19
Pneumonia	22	13	17	21	Mem. Croup	9	9	5	10	Measles	7	7	3	4	20
Scarlatina	16	12	13	9	Cholera Morbus	7	6	7	12	Dysentery	7	7	7	8	21
Mem. Croup	6	8	3	7	Measles	6	5	3	4	Infl. of Brain‡	5	6	6	5	22
Puerperal F	5	6	5	6	Cholera Infantum	4	5	4	7	Puerperal F	5	5	7	7	23
Cer.-spinal Men.	4	4	5	5	Puerperal F	5	4	7	6	Cholera Morbus	5	5	5	9	24
Measles	5	4	1	4	Infl. of Brain‡	5	4	5	8	Cer.-spinal Men.	4	4	4	8	25
Infl. of Brain‡	5	4	5	5	Cer.-spinal Men.	3	3	2	4	Cholera Infantum	2	2	2	3	26
Small-pox	0.5	0.9	0	0	Small-pox	0.8	0.7	0	0	Small-pox	0.7	0.4	0	0	27
Reports received.§	369	446	495	362	Reports received.§	341	433	498	301	Reports received.§	367	504	580	372	

*, †, ‡. See notes with these marks on page 115.
§ For this foot-note see page 116.

EXHIBIT V.—*By Months and by Geographical Divisions of the State, the Names of 169 Observers whose Weekly Reports of Diseases for 1886 are Compiled in Tables 1, 2, 3, and 4, the Localities*[a] *for which they Report, and the Number of Reports received from each Observer.*

Divisions and Localities Represented and Physicians who Reported. (Health officers in italics; those also regular correspondents marked *.)	Weekly Reports in 1886.—Compiled for this Article. Year, 1886.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
All Localities	*5583*	*448*	*465*	*530*	*368*	*398*	*508*	*446*	*470*	*567*	*446*	*433*	*504*
Upper Peninsular Division †	*156*	*11*	*12*	*14*	*10*	*12*	*12*	*11*	*12*	*14*	*11*	*18*	*19*
Houghton, *H. W. Jones, M. D.**	50	4	4	5	3	4	4	4	4	5	4	4	5
Ishpeming, *T. A. Felch, M. D.*	9	---	---	---	---	---	---	---	---	---	---	4	5
Ishpeming, W. E. Harwood, M. D.	23	3	4	5	4	4	3	---	---	---	---	---	---
Mackinac, *Samuel S. Jessop, M. D.*	43	4	4	4	3	4	---	4	4	4	4	4	4
Negaunee, *C. S. Lombard, M. D.*	2	---	---	---	---	---	---	---	---	---	---	2	---
Newberry, *S. John Fraser, M. D.*	29	---	---	---	---	---	5	3	4	5	3	4	5
Northwestern Division †	*75*	*4*	*4*	*5*	*4*	*4*	*8*	*7*	*6*	*10*	*6*	*7*	*10*
Frankfort, *I. Voorheis, M. D.*	26	---	---	---	---	---	3	3	2	5	4	4	5
Manistee, *L. S. Ellis, M. D.*	40	4	4	5	4	4	---	---	4	5	2	3	5
Manistee, *J. F. Hincks, M. D.*	9	---	---	---	---	---	5	4	---	---	---	---	---
Northern Division †	*161*	*16*	*16*	*18*	*8*	*8*	*14*	*16*	*14*	*14*	*12*	*10*	*15*
Charlevoix, *W. M. Preston, M. D.*	34	4	4	5	4	4	5	4	4	---	---	---	---
Elk Rapids, *A. B. Conklin, M. D.*	13	4	4	5	---	---	---	---	---	---	---	---	---
Evangeline Tp., A. W. Nicholson, M. D.	11	4	4	3	---	---	---	---	---	---	---	---	---
Harbor Springs, *L. W. Gardner, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Mackinaw City, *H. P. Smith, M. D.*	28	---	---	---	---	---	4	4	4	5	4	2	5
Petoskey, W. A. S. Williams, M. D.	23	---	---	---	---	---	---	4	2	4	4	4	5
Northeastern Division †	*157*	*12*	*12*	*14*	*12*	*12*	*14*	*11*	*10*	*14*	*15*	*16*	*15*
Alpena, *J. D. Dunlop, M. D.*	17	---	---	---	---	---	---	---	---	4	4	4	5
East Tawas, *J. S. Reeves, M. D.**	51	4	4	5	4	4	4	4	4	5	4	4	5
Harrisville, D. W. Mitchell, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Tawas City, *J. H. Vaughan, M. D.*	37	4	4	4	4	4	5	3	2	---	3	4	---
Western Division †	*563*	*42*	*42*	*52*	*35*	*33*	*42*	*41*	*50*	*63*	*51*	*48*	*54*
Grand Haven, *J. N. Reynolds, M. D.*	17	4	4	5	4	---	---	---	---	---	---	---	---
Grand Rapids, A. Hazlewood, M. D.*	51	4	4	5	4	3	5	4	4	5	4	4	5
Grandville, *J. W. Cooper, M. D.*	10	4	3	3	---	---	---	---	---	---	---	---	---
Hart, A. A. Dunton, Jr., M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Holland, *H. Kremers, M. D.*	15	---	---	---	---	---	---	3	4	5	3	---	---
Lakeside, *F. A. Jones, M. D.*	25	---	---	---	---	---	---	4	4	5	4	4	4
Lowell, *A. M. Elsworth, M. D.*	39	4	4	5	4	---	---	---	4	5	4	4	5
Lowell, *N. I. Tibbetts, M. D.*	30	---	---	---	---	4	5	4	4	5	4	4	---
Ludington, *F. W. Graham, M. D.*	35	---	---	---	---	4	5	4	4	5	4	4	5
Montague, *L. E. Jones, M. D.*	21	---	---	---	---	---	---	---	3	5	4	4	5
Montague, *J. W. Switzer, M. D.*	15	4	4	5	2	---	---	---	---	---	---	---	---
Muskegon, J. P. Stoddard, M. D.	49	4	4	5	4	4	4	4	4	3	4	4	5
Muskegon, *C. L. Thompson, M. D.*	15	4	4	5	2	---	---	---	---	---	---	---	---
North Muskegon, *G. C. Havens, M. D.*	51	3	4	5	4	4	5	4	4	5	4	4	5
Pentwater, G. H. Cleveland, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Sand Lake, *F. Chappell, M. D.*	15	3	3	4	3	2	---	---	---	---	---	---	---
Shelby, *R. G. Cavanah, M. D.*	34	---	---	---	---	4	5	3	4	5	4	4	5
Whitehall, *C. E. Walters, M. D.*	27	---	---	---	---	---	3	3	3	5	4	4	5
Northern Central Division †	*200*	*8*	*8*	*10*	*4*	*15*	*18*	*17*	*25*	*34*	*19*	*18*	*24*
Big Rapids, *I. W. Badger, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Clare, *J. H. Carpenter, M. D.*	21	---	---	---	---	4	5	4	4	4	---	---	---
Farwell, *E. B. Evans, M. D.*	23	---	---	---	---	---	---	3	3	5	4	4	4
Gladwin, *R. E. Finch, M. D.*	7	---	---	---	---	---	---	---	2	5	---	---	---
Harrison, H. Thompson, M. D.	24	---	---	---	---	3	---	---	4	5	3	4	5
Lake Township, V. F. Huntley, M. D.	13	4	4	5	---	---	---	---	---	---	---	---	---
Midland City, T. J. Secor, M. D.	28	---	---	---	---	---	3	4	4	5	4	3	5
Morley, B. H. McMullen, M. D.	21	---	---	---	---	---	---	---	4	5	4	3	5
Reed City, D. S. Taplin, M. D.	11	---	---	---	---	4	5	2	---	---	---	---	---
Bay and Eastern Division †	*846*	*64*	*69*	*76*	*57*	*63*	*76*	*69*	*71*	*87*	*68*	*64*	*82*
Algonac, W. K. Moore, M. D.	51	4	4	4	4	4	5	4	4	5	4	4	5
Almont, Adam Price, M. D.	46	2	4	3	4	4	3	4	4	5	4	4	5
Attica, J. W. Curnalia, M. D.	35	---	---	---	---	4	5	4	4	5	4	4	5
Bay City, J. W. Caughlin, M. D.	45	2	2	3	3	4	5	4	4	5	4	4	5

a In many cases the reports include sickness in the vicinity as well as the corporate limits of the places named.

* Regular correspondent. † For counties in each division see Exhibit I., page 111.

EXHIBIT V.—CONTINUED.

Divisions and Localities Represented and Physicians who Reported. (Health Officers in italics: those also regular correspondents marked *.)	Weekly Reports in 1886.—Compiled for this Article. Year 1886.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Bay and Eastern Division.—*Continued*...†													
Brown City, J. A. Watson, M. D.	49	4	4	5	4	3	4	4	4	4	4	4	5
Capac, J. R. McGurk, M. D.	48	----	4	5	4	4	5	4	4	5	4	4	5
Cass City, J. H. McLean, M. D.	17	2	2	----	----	----	----	----	3	4	3	----	3
Columbiaville, C. A. Wisner, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Croswell, H. Carey, M. D.	13	----	----	----	3	4	4	2	----	----	----	----	----
Croswell, J. Steel, M. D.	6	3	3	----	----	----	----	----	----	----	----	----	----
Emmett, A. J. Abbot, M. D.	26	4	2	4	----	2	----	4	4	4	2	----	----
Essexville, A. J. Harris, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Fort Gratiot, S. W. Merritt, M. D.	22	----	----	----	----	----	----	----	4	5	4	4	5
Lapeer, *A. E. Burdick, M. D.*	11	3	4	4	----	----	----	----	----	----	----	----	----
Marine City, *D. L. Parker, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Metamora, *G. W. Stone, M. D.*	51	4	4	5	4	4	5	4	4	5	3	4	5
Port Huron, *C. C. Claney, M. D.*	34	2	----	----	----	2	5	4	4	5	4	4	4
Saint Charles, *C. M. Bradt, M. D.*	16	4	4	5	3	----	----	----	----	----	----	----	----
Sand Beach, H. R. Hitchcock, M. D.	51	4	4	4	4	4	5	4	4	5	4	4	5
Sandusky, *L. C. Read, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Sebawaing, *J. Black, M. D.*	14	3	4	4	----	----	----	3	----	----	----	----	----
Thornville, *J. S. Caulkins, M. D.*	51	3	4	5	4	4	5	4	4	5	4	4	5
Vassar, *T. A. Cullis, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Central Division.....†	*1,005*	*89*	*95*	*103*	*64*	*69*	*95*	*86*	*82*	*87*	*79*	*77*	*79*
Assyria, C. E. Fay, M. D.	40	4	4	5	2	3	4	4	2	----	3	4	5
Durand, A. G. Cowles, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Edmore, *L. A. Roller, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Flint, *O. Millard, M. D.*	27	4	4	----	3	4	5	3	----	----	4	----	----
Grand Ledge, *C. E. Covey, M. D.*	24	----	----	----	----	----	3	4	4	5	4	4	----
Greenville, *H. L. Bower, M. D.*	33	----	----	----	----	3	5	4	4	4	4	4	5
Greenville, C. M. Martin, M. D.	50	4	4	5	4	4	5	4	4	5	2	4	5
Hastings, A. P. Drake, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Hastings, *D. E. Fuller, M. D.*	15	4	4	5	2	----	----	----	----	----	----	----	----
Hastings, *E. H. Lathrop, M. D.*	33	----	----	----	----	4	5	4	4	4	4	4	4
Howard City, *J. N. Hathaway, M. D.*	35	----	----	----	3	2	4	4	4	5	4	4	5
Hubbardston, *C. S. Park, M. D.*	51	4	4	5	4	4	5	4	4	5	4	4	4
Ithaca, C. L. Barber, M. D.	42	4	4	4	3	4	5	4	4	----	4	3	3
Ithaca, *J. P. Carpenter, M. D.*	13	3	4	4	2	----	----	----	----	----	----	----	----
Lakeview, *A. H. Forsyth, M. D.*	51	4	3	5	4	4	5	4	4	5	4	4	5
Lansing, H. Ostrander, M. D.	28	----	4	3	----	3	----	4	4	5	2	3	----
Lansing, J. H. Wellings, M. D.	34	4	4	5	4	4	5	4	4	----	----	----	----
Lyons, B. M. Hutchinson, M. D.	29	----	----	----	----	----	3	4	4	5	4	4	5
McBride, *R. P. Comfort, M. D.*	11	3	4	4	----	----	----	----	----	----	----	----	----
McBride, *W. P. Gamber, M. D.*	29	----	----	----	----	----	3	4	4	5	4	4	5
Maple Rapids, *R. H. Sanborn, M. D.*	25	----	----	----	----	4	3	3	4	4	4	3	----
Middleville, *G. W. Matteson, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Mount Morris, *F. A. Cady, M. D.*	10	3	4	3	----	----	----	----	----	----	----	----	----
Owosso, *S. S. C. Phippen, M. D.*	16	4	4	5	3	----	----	----	----	----	----	----	----
Pierson, J. Totten, M. D.	51	4	4	5	4	4	5	4	4	5	4	4	4
Portland, *G. D. Allen, M. D.*	16	4	4	5	3	----	----	----	----	----	----	----	----
St. Johns, *L. W. Fasquelle, M. D.*	13	4	4	5	----	----	----	----	----	----	----	----	----
Sheridan, *W. H. Budd, M. D.*	48	4	4	5	3	2	5	4	4	5	4	4	4
Vermontville, *P. L. Green, M. D.*	8	4	4	----	----	----	----	----	----	----	----	----	----
Vernon, *W. H. Holtzman, M. D.*	13	4	4	5	----	----	----	----	----	----	----	----	----
Woods Corners, G. Pray, M. D.....*	52	4	4	5	4	4	5	4	4	5	4	4	5
Southwestern Division.....†	*604*	*44*	*43*	*49*	*37*	*38*	*48*	*39*	*43*	*60*	*33*	*35*	*45*
Benton Harbor, *I. R. Dunning, M. D.*	49	4	4	5	4	4	5	4	4	3	3	4	5
Berrien Springs, *A. J. Dispennett, M. D.*	21	----	----	----	----	4	5	4	4	4	----	----	----
Bloomingdale, *W. B. Hathaway, M. D.*	51	4	3	5	4	4	5	4	4	5	4	4	5
Decatur, *G. L. Rose, M. D.*	43	4	4	5	4	4	3	----	3	5	2	4	5
Hartford, *H. C. Maynard, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Lawrence, *A. S. Haskin, M. D.*	29	----	----	----	----	----	3	4	4	5	4	4	5
Niles, *O. P. Horn, M. D.*	51	4	4	5	3	4	5	4	4	5	4	4	5
Otsego, *M. Chase, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Otsego, *L. E. Clark, M. D.*	20	----	----	----	----	4	5	3	4	4	----	----	----
Plainwell, *B. Thompson, M. D.*	18	4	4	5	3	2	----	----	----	----	----	----	----
Saugatuck, J. B. Cook, M. D.	25	----	----	----	----	----	----	4	4	4	4	4	5
Saugatuck, *H. H. Stimson, M. D.*	8	4	4	----	----	----	----	----	----	----	----	----	----
South Haven, *M. E. Bishop, M. D.*	17	4	4	5	4	----	----	----	----	----	----	----	----
South Haven, G. D. Carnes, M. D.	28	----	----	----	----	----	3	4	4	5	4	3	5
Three Oaks, *F. F. Sovereign, M. D.*	15	4	4	4	3	----	----	----	----	----	----	----	----
Wayland, H. J. Turner, M. D.	25	4	4	5	4	4	4	----	----	----	----	----	----

* Regular Correspondent and Health Officer.
† For counties in each division see Exhibit I, page 111.

EXHIBIT V.— CONTINUED.

Divisions and Localities Represented, and Physicians who Reported. (Health Officers in Italics; those also regular correspondents marked *.)	Weekly Reports in 1886.—Compiled for this Article.												
	Year 1886.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Southern Central Division.....†	*1,111*	*90*	*94*	*113*	*83*	*84*	*107*	*86*	*86*	*104*	*87*	*82*	*95*
Adrian, *J. Tripp, M. D.*	51	4	4	4	4	4	5	4	4	5	4	4	5
Ann Arbor, *J. Kapp, M. D.*	20	---	---	---	---	---	4	4	4	4	4	---	---
Bronson, *H. P. Mowry, M. D.*	11	---	---	---	---	---	---	3	2	---	3	3	---
Burr Oak, *J. Rollman, M. D*	52	4	4	5	4	4	5	4	4	5	4	4	5
Coldwater, *L. A. Warsaba, M. D.*	48	3	4	5	4	4	5	3	3	5	4	3	5
Constantine, S. C. Culp, M. D.	13	4	4	5	---	---	---	---	---	---	---	---	---
Hillsdale, *E. Hughes, M. D.*	19	---	---	---	---	---	---	2	3	3	4	4	3
Hudson, *A. R. Smart, M. D.*	29	4	4	5	4	4	5	3	---	---	---	---	---
Jackson (Prison) W. H. Palmer, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Jonesville, *H. M. Warren, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Kalamazoo, H. B. Hemenway, M. D.	48	4	4	5	4	2	3	4	4	5	4	4	5
Kalamazoo, *Wm. Mottram, M. D.*	43	2	2	5	4	4	5	3	---	5	4	4	5
Kalamazoo, H. H. Schaberg, M. D.	47	4	4	5	4	4	5	4	4	---	4	4	5
Kalamazoo, *W. B. Southard, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Litchfield, *E. P. Buckley, M. D*	52	4	4	5	4	4	5	4	4	5	4	4	5
Marshall, *E. J. Marshall, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Mendon, H. C. Clapp, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Morenci, *N. H. Bailey, M. D.*	50	3	4	5	4	4	5	4	4	5	4	4	4
Parma, *O. S. Hartson, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Reading, *E. H. Damon, M. D.*	13	4	4	5	---	---	---	---	---	---	---	---	---
Reading, *W. H. Miller, M. D.*	11	---	---	---	---	4	---	2	2	3	---	---	---
Reading, B. G. Strong, M. D.	8	4	4	---	---	---	---	---	---	---	---	---	---
Richland, *J. M. Rankin, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Springport, *A. W. Troupe, M. D.*	49	4	4	5	4	3	5	4	4	5	4	4	3
Tecumseh, *C. M. Woodward, M. D.*	16	4	4	5	3	---	---	---	---	---	---	---	---
Tekonsha, *J. L. Ramsdell, M. D.*	8	---	---	---	---	---	---	---	4	4	---	---	---
Union City, R. P. Beebe, M. D.	47	3	4	4	4	3	5	2	4	5	4	4	5
Vicksburg, *C. H. McKain, M. D.*	51	3	4	5	4	4	5	4	4	5	4	4	5
Vicksburg, *C. E. Spicer, M. D.*	35	---	---	---	---	4	5	4	4	5	4	4	5
Ypsilanti, *E. Batwell, M. D.*	26	4	4	5	4	4	5	---	---	---	---	---	---
Southeastern Division.....†	*815*	*68*	*70*	*76*	*54*	*60*	*74*	*63*	*71*	*90*	*65*	*58*	*66*
Armada, *S. T. Beardslee, M. D.*	24	---	---	---	---	---	---	4	4	5	4	4	3
Armada, C. H. Lincoln, M. D.*	37	4	4	5	2	---	---	---	4	5	4	4	5
Birmingham, *J. L. Campbell, M. D.*	41	3	4	5	4	4	5	4	4	5	3	---	---
Clarkston, *C. G. Robertson, M. D.*	35	---	---	---	---	4	5	4	4	5	4	4	5
Detroit, W. H. Rouse, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Dundee, *J. B. Haynes, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Holly, *L. E. Wickens, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Memphis, *D. H. Cole, M. D.*	52	4	4	5	4	4	5	4	4	5	4	4	5
Monroe, *G. B. McCallum, M. D.*	42	4	4	5	4	4	4	3	4	5	3	2	---
New Baltimore, *D. Hammell, M. D.*	17	4	4	5	4	---	---	---	---	---	---	---	---
Northville, *J. M. Burgess, M. D.*	51	4	4	5	4	4	5	4	4	5	3	4	5
Northville, J. M. Swift, M. D.	52	4	4	5	4	4	5	4	4	5	4	4	5
Plymouth, J. M. Collier, M. D.	10	3	4	3	---	---	---	---	---	---	---	---	---
Pontiac, *W. G. Elliott, M. D.*	8	4	4	---	---	---	---	---	---	---	---	---	---
Pontiac, *M. W. Gray, M. D.*	37	---	---	---	2	4	5	4	4	5	4	4	5
Richmond, *C. Mills, M. D.*	24	2	2	---	---	---	---	---	3	5	4	4	4
Rochester, *H. A. Stonex, M. D.*	35	---	---	---	---	4	5	4	4	5	4	4	5
Romeo, Wm. Greenshields, M. D.	51	4	4	5	4	4	5	4	4	5	4	4	4
Romeo, *J. P. Letts, M. D.*	41	4	4	5	4	4	5	4	4	5	2	---	---
South Lyon, *F. E. Holmes, M. D.*	15	4	4	5	2	---	---	---	---	---	---	---	---
Wayne *J. M. Truscott, M. D.*	51	4	4	5	4	4	5	4	4	5	3	4	5
Wyandotte, *E. P. Christian, M. D.*	11	4	4	3	---	---	---	---	---	---	---	---	---
Wyandotte, *T. J. Langlois, M. D.*	25	---	---	---	---	4	5	4	4	5	3	---	---

* Regular Correspondent and Health Officer.
† For counties in each division see Exhibit I, page 111.

Foot-notes from page 121.

ǂ The numbers opposite the names of the diseases do not state what per cent of the whole number of observers for the year reported the disease present at some time during the year, but state (on an average for the twelve months of the year) by what per cent of the observers making reports for the several months, the disease was reported present in those months. The column for each year is thus a statement for an average month of that year. On the two following pages of this table, however, the columns for each month state what per cent of the observers for that month (the number of whom is stated at the foot of the column) reported the given disease in that month.

‡ Consumption, remittent fever, and typho-malarial fever were not printed on the first blanks used in making weekly reports (beginning with the month of September, 1876); neuralgia and tonsilitis were not printed on any blanks used prior to October, 1878, and not on all used for several months after that date; inflammation of brain and inflammation of bowels were not printed on any blanks used prior to July, 1879, and not on all used for several months after that date; inflammation of kidney was not printed on any blanks used prior to October, 1883, and not on all used for several months after that date; hence it is probable that these diseases were not so fully reported at first as were the other diseases.

TABLE 1.—*Stating, for each of the ten Years 1877-1886, and the Average for 1877-1886, by what Per Cent of Observers each of 27 Diseases was reported present in those Years (also the Average Number of Observers per Month and the Total Observers for each Year).—Compiled from Weekly Reports of Health Officers of Cities and Villages and from Regular Correspondents of the State Board of Health.*—Diseases arranged in order of Greatest Number of Observers reporting them present in 1886.—(Continued, for each Month of several of the above mentioned Years, on pages 122 and 123.)*

Line Number.	Diseases.	Observers by Whom the Several Diseases were Reported Present.—Average Per Cent† (per Month) of those making Reports.										
		Av. 1877-86.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.	1878.	1877.
	Av. for Tabulated Diseases reported present	41	37	38	42	43	43	45	43	44	39	38
1	Rheumatism	83	85	83	83	83	85	84	85	85	81	78
2	Neuralgia‡	82	83	83	84	85	85	78	79	75	.....	.....
3	Intermittent Fever	83	71	73	79	82	83	90	90	90	90	85
4	Bronchitis	75	71	70	74	79	80	74	77	75	75	71
5	Tonsilitis‡	70	70	72	73	73	72	65	67	68	.....	.....
6	Diarrhea	65	64	66	71	67	69	67	63	65	57	58
7	Consumption, Pulmonary‡	72	64	68	72	71	74	78	76	78	76	61
8	Remittent Fever‡	62	48	52	60	57	64	66	67	69	71	68
9	Pneumonia	56	48	44	48	59	61	60	62	60	58	56
10	Influenza	53	48	47	53	56	55	48	54	57	57	54
11	Erysipelas	42	43	44	48	47	42	42	45	43	35	35
12	Inflammation of Kidney‡	37	35	34	41	.....	.....	.....	.....	.....	.....	.....
13	Inflammation of Bowels‡	29	32	32	30	31	28	26	25	.....	.....	.....
14	Dysentery	32	30	28	38	35	31	34	30	31	30	34
15	Cholera Morbus	32	29	33	37	32	31	41	34	34	25	26
16	Whooping-cough	28	28	21	29	23	26	24	42	31	28	28
17	Typho-malarial Fever‡	34	27	27	32	32	39	43	37	32	35	37
18	Cholera Infantum	23	25	21	26	24	22	27	23	23	20	17
19	Diphtheria	36	24	27	27	31	43	51	43	45	37	32
20	Scarlatina	30	20	22	29	32	32	32	26	36	38	33
21	Typhoid Fever (Enteric)	20	15	16	20	19	24	26	21	18	16	22
22	Inflammation of Brain‡	13	13	14	14	12	12	12	13	.....	.....	.....
23	Puerperal Fever	12	12	13	16	15	18	12	8	8	6	10
24	Membranous Croup	14	12	10	14	14	15	19	13	16	14	14
25	Measles	20	10	9	17	37	20	37	30	18	7	12
26	Cerebro-Spinal Meningitis	9	8	12	12	11	12	16	6	5	6	6
27	Small-pox	2	0.5	0.4	0.2	1	5	4	1	1	1	5
	Number of Observers	132	169	163	142	140	159	116	112	110	97	115
	Av. No. of Observers per Month	83	113	104	79	88	93	70	79	73	64	66

* For 1886 the number of observers, reports, weeks in each month, etc., are stated in the first five columns of Exhibit III., page 114, the names of the observers and the number of the reports received from each are stated in Exhibit V., pages 118-120.

† ‡ Balance of foot-notes on preceding page.]

TABLE 1.—CONTINUED.*—*Per Cent of Observers by whom the Several Diseases were ten years,*

Per Cent of Observers by whom the Diseases were Reported Present.

Line Number.	January.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	February.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	March.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.
	Average.....†	42	37	38	41	44	Average.....†	41	37	38	40	42	Average.....†	42	41	40	41	44
1	Rheumatism.....	88	86	85	81	96	Rheumatism.....	85	85	86	81	84	Neuralgia.....‡	88	89	87	84	91
2	Neuralgia.....‡	84	85	89	84	96	Tonsilitis.....‡	80	83	82	79	82	Rheumatism.....	86	88	87	82	80
3	Bronchitis.....	86	81	82	83	90	Bronchitis.....	87	82	85	81	90	Bronchitis.....	87	86	85	80	91
4	Tonsilitis.....‡	80	78	78	79	87	Neuralgia.....‡	84	82	89	84	91	Tonsilitis.....‡	80	83	77	77	82
5	Consumpt'n Pul..‡	73	68	64	65	80	Pneumonia.....	80	68	73	73	78	Pneumonia.....	80	80	75	63	83
6	Pneumonia.....	78	62	69	79	80	Intermittent F...	74	66	65	65	77	Influenza.....	71	78	63	61	82
7	Intermittent F....	74	61	60	71	76	Consumpt'n,Pul‡	73	66	72	65	80	Consumpt'n,Pul‡	76	72	80	75	75
8	Influenza.....	69	55	67	69	66	Influenza.....	71	63	69	74	74	Intermittent F...	78	71	63	73	76
9	Remittent F.....‡	56	50	43	58	57	Diarrhea.....	44	48	49	48	52	Remittent F.....‡	55	48	52	53	54
10	Erysipelas.....	48	47	49	51	54	Remittent F.....‡	52	43	45	53	47	Diarrhea.....	47	46	52	46	49
11	Diarrhea.....	46	45	40	51	54	Erysipelas.....	45	39	55	44	53	Erysipelas.....	46	44	54	42	47
12	Infl. of Kidney ..‡	...	34	35	45	...	Infl. of Kidney ..‡	...	37	39	46	...	Infl. of Kidney..‡	...	41	41	41	...
13	Diphtheria.....	44	33	22	35	43	Infl. of Bowels..‡	25	28	31	21	29	Infl. of Bowels..‡	29	31	31	27	24
14	Infl. of Bowels...‡	25	26	21	24	30	Diphtheria.....	39	27	20	20	39	Scarlatina.....	39	29	24	39	40
15	Whooping-cough.	29	22	24	34	22	Scarlatina.....	38	25	30	40	33	Typho-mal. F...‡	23	25	21	15	21
16	Scarlatina.....	37	20	28	34	40	Whoop'g-cough..	27	22	20	30	23	Diphtheria.....	37	25	20	25	34
17	Typho-mal. F....‡	29	18	24	25	32	Typho-mal. F...‡	24	15	27	19	26	Whooping-cough	27	23	28	29	20
18	Mem. Croup.....	25	16	29	19	21	Mem. Croup.....	20	13	18	19	19	Puerperal Fever	15	18	17	18	16
19	Infl. of Brain....‡	12	14	15	19	7	Dysentery.....	12	13	13	11	14	Cer.-spinal Men.	12	17	18	14	13
20	Dysentery.....	15	13	15	21	24	Infl. of Brain...‡	13	12	13	14	11	Dysentery.....	16	16	17	20	21
21	Puerperal Fever..	13	12	8	18	16	Puerperal Fever	11	12	7	16	13	Infl. of Brain ...‡	14	16	18	16	10
22	Cholera Morbus..	10	10	10	11	18	Cer.-spinal Men.	9	10	14	14	11	Measles.....	26	15	14	25	43
23	Typhoid Fever...	19	8	18	19	21	Measles.....	20	9	10	29	32	Cholera Morbus.	14	12	18	18	16
24	Cer.-spinal Men...	7	8	10	13	3	Typhoid Fever..	14	7	11	13	9	Mem. Croup.....	17	11	18	11	16
25	Measles.....	17	7	7	26	33	Cholera Morbus.	11	4	8	13	16	Typhoid Fever..	12	9	10	16	10
26	Cholera Infant'm	5	3	10	3	9	Cholera Infan'm	4	2	3	5	8	Cholera Infan'm	5	6	3	5	7
27	Small-pox.....	3	0	0	0	2	Small-pox.....	2	0	1	0	2	Small-pox.....	1	0	1	0	0
	Observers.....§	82	119	72	80	90	Observers.....§	82	120	71	80	90	Observers.....§	80	112	71	79	87

Line Number.	April.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	May.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	June.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.
	Average.....†	41	38	39	43	45	Average.....†	40	37	36	40	45	Average.....†	39	37	35	39	41
1	Rheumatism.....	88	89	90	88	93	Rheumatism.....	86	86	87	89	89	Rheumatism.....	84	86	84	86	85
2	Neuralgia.....‡	87	85	88	91	93	Neuralgia.....‡	82	83	83	89	86	Neuralgia.....‡	81	79	81	81	85
3	Bronchitis.....	84	82	80	82	85	Bronchitis.....	78	73	72	76	89	Intermittent F...	88	79	75	79	89
4	Intermittent F...	83	74	72	82	79	Intermittent F...	87	70	77	81	85	Bronchitis.....	69	69	69	69	75
5	Influenza.....	65	72	61	60	73	Consumpt'n,Pul‡	76	68	71	74	77	Diarrhea.....	65	67	62	65	69
6	Tonsilitis.....‡	74	71	70	78	81	Tonsilitis.....‡	70	63	74	80	78	Consump'n, Pul.	71	65	70	74	69
7	Consumpt'n,Pul.‡	76	69	80	76	71	Diarrhea.....	56	52	56	68	63	Tonsilitis.....‡	65	64	65	67	60
8	Pneumonia.....	76	67	72	69	75	Erysipelas.....	48	51	46	47	54	Remittent F.....‡	63	54	50	50	59
9	Diarrhea.....	50	51	51	66	53	Pneumonia.....	64	51	42	47	76	Pneumonia.....	45	43	35	33	43
10	Remittent F.....‡	59	49	51	65	55	Remittent F.....‡	61	48	46	53	56	Erysipelas.....	42	42	41	48	50
11	Erysipelas.....	47	48	49	54	51	Influenza.....	53	45	46	55	64	Influenza.....	40	42	33	38	48
12	Infl. of Kidney..‡	...	40	35	47	...	Infl. of Kidney ..‡	...	36	36	42	...	Infl. of Kidney..‡	...	40	32	43	...
13	Infl. of Bowels...‡	25	27	33	26	32	Infl. of Bowels..‡	28	36	34	26	31	Infl. of Bowels..‡	29	32	33	30	31
14	Scarlatina.....	36	23	26	46	35	Whooping-cough	29	32	14	31	30	Whooping-cough	28	31	15	31	19
15	Diphtheria.....	35	21	20	28	32	Diphtheria.....	30	25	16	32	28	Cholera Infan'm	24	27	15	23	18
16	Whooping-cough.	26	21	25	31	24	Scarlatina.....	32	21	23	43	36	Cholera Morbus.	39	27	37	48	31
17	Puerperal Fever .	11	18	17	15	13	Typho-mal. F...‡	21	20	21	22	31	Typho-mal. F...‡	23	20	20	25	26
18	Typho-mal. F....‡	20	18	16	22	22	Dysentery.....	17	18	14	18	24	Scarlatina.....	28	20	22	26	28
19	Infl of Brain....‡	16	17	26	15	15	Measles.....	37	17	18	30	71	Diphtheria.....	28	18	24	21	28
20	Dysentery.....	15	12	20	21	16	Cholera Morbus.	19	16	22	18	24	Dysentery.....	25	17	18	27	32
21	Cholera Morbus..	14	11	17	15	16	Cholera Infan'm	8	12	12	11	13	Infl. of Brain....‡	13	16	15	12	11
22	Measles.....	32	9	20	26	56	Infl. of Brain...‡	13	11	14	12	13	Measles.....	31	15	12	20	60
23	Cer.-spinal Men...	13	8	16	22	14	Mem. Croup.....	11	10	7	12	16	Puerperal Fever.	13	15	12	15	13
24	Mem. Croup.....	14	7	13	10	19	Pnerperal Fever	12	10	13	14	20	Mem. Croup.....	8	8	6	7	14
25	Cholera Infant'm	5	5	3	12	9	Typhoid Fever..	10	7	10	9	13	Typhoid Fever...	10	7	9	7	17
26	Typhoid Fever...	11	5	10	13	12	Cer.-spinal Men..	11	7	12	12	11	Cer.-spinal Men.	9	5	11	7	10
27	Small-pox.....	3	0	1	1	0	Small-pox.....	3	0	1	1	1	Small-pox.....	3	1	1	0	1
	Observers.....§	75	100	69	68	85	Observers.....§	80	105	94	74	87	Observers.....§	82	109	108	84	88

* For 1886 the number of observers, reports, weeks in each month, etc., are stated in the first five columns of Exhibit III., page 114, the names of observers and the number of reports received from each are stated in Exhibit V., pages 118-120. † The numbers in this line are an average, not for all diseases represented, but only for those reported present in the given month. ‡ See foot-note with this mark on page 120. § The numbers in this line state how many observers reported for the month in the given year. aFor first part of Table 1, and full heading, see page 121.

Reported Present by Months in each of Years 1883–1886, and the Average for the 1877–1886.

Per Cent of Observers by whom the Diseases were Reported Present.

July.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	Line Number.
Average.....†	42	38	40	45	42	
Diarrhea	91	87	89	93	87	1
Rheumatism	78	82	82	79	80	2
Neuralgia	78	81	80	82	81	3
Intermitt. Fever	90	79	80	87	87	4
Cholera Morbus	71	68	70	72	60	5
Consump., Pul.	69	58	65	74	68	6
Bronchitis	59	56	57	66	73	7
Tonsilitis	55	55	61	61	66	8
Remitt'nt Fever	67	53	50	66	58	9
Cholera Infant.	48	49	39	48	44	10
Dysentery	51	43	30	55	45	11
Erysipelas	41	41	44	59	41	12
Infl. of Bowels	34	35	34	36	27	13
Whooping-cough	32	34	21	37	32	14
Infl. of Kidney	...	33	33	39	...	15
Typho-mal. F.	28	27	20	28	24	16
Influenza	31	25	27	39	35	17
Pneumonia	32	21	25	32	29	18
Diphtheria	28	16	28	30	26	19
Inflam. of Brain	13	14	16	14	15	20
Typhoid Fever	13	12	20	28	24	21
Scarlatina	24	12	23	25	29	22
Cer.-spi. Men.	9	11	17	9	15	23
Puerperal Fever	11	8	15	17	16	24
Measles	23	8	15	16	42	25
Mem. Croup	5	5	4	7	7	26
Small-pox	3	1	0	0	1	27
Observers.....§	86	118	122	87	95	

August.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	Line Number.
Average.....†	43	39	40	39	48	
Diarrhea	97	94	96	96	97	1
Intermitt. Fever	90	76	80	85	91	2
Rheumatism	74	76	76	81	76	3
Neuralgia	74	75	72	74	82	4
Cholera Morbus	77	68	69	70	74	5
Cholera Infant.	67	68	58	62	64	6
Dysentery	74	65	59	70	71	7
Consump., Pul.	66	59	61	73	64	8
Bronchitis	55	54	51	64	70	9
Tonsilitis	53	52	57	57	63	10
Remitt'nt Fever	71	47	57	64	62	11
Erysipelas	35	38	59	70	71	12
Whooping-cough	32	37	23	35	23	13
Infl. of Bowels	36	37	39	36	43	14
Typho-mal. F.	40	30	26	39	38	15
Infl. of Kidney	...	30	31	32	...	16
Typhoid Fever	23	24	13	23	21	17
Pneumonia	26	22	21	21	39	18
Influenza	33	20	32	40	36	19
Diphtheria	29	18	25	24	30	20
Infl. of Brain	16	13	13	17	17	21
Scarlatina	21	13	15	20	27	22
Puerperal Fever	11	11	13	17	19	23
Measles	13	9	3	10	22	24
Cer.-spi. Men.	9	6	12	13	7	25
Mem. Croup	6	6	2	7	8	26
Small-pox	1.2	1	0	0	0	27
Observers.....§	89	123	127	84	98	

September.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	Line Number.
Average.....†	45	42	43	46	46	
Diarrhea	95	92	88	94	95	1
Rheumatism	76	84	78	75	75	2
Neuralgia	78	83	78	80	75	3
Intermitt. Fever	90	77	85	86	86	4
Cholera Infant.	59	69	45	68	53	5
Dysentery	71	69	57	76	77	6
Cholera Morbus	66	66	55	71	63	7
Tonsilitis	60	65	70	65	67	8
Consump., Pul.	67	57	66	71	64	9
Remitt'nt Fever	74	55	63	74	67	10
Bronchitis	62	54	66	61	68	11
Typho-mal. F.	57	44	41	50	51	12
Erysipelas	35	40	39	41	34	13
Infl. of Bowels	32	40	27	40	29	14
Influenza	43	39	49	48	41	15
Whooping-cough	30	36	23	28	22	16
Typhoid Fever	31	29	21	29	29	17
Pneumonia	31	27	30	19	39	18
Infl. of Kidney	...	26	28	31	...	19
Diphtheria	32	23	31	21	23	20
Scarlatina	22	15	16	16	26	21
Inflam. of Brain	13	11	12	16	11	22
Mem. Croup	9	11	8	9	11	23
Puerperal Fever	11	10	12	16	10	24
Measles	9	9	3	8	14	25
Cer.-spi. Men.	10	8	15	13	15	26
Small-pox	1	1	0	0	0	27
Observers.....§	86	118	128	80	92	

October.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	Line Number.
Average.....†	44	38	38	48	43	
Rheumatism	83	86	77	85	80	1
Neuralgia	80	81	78	84	82	2
Intermitt. Fever	88	76	74	84	86	3
Diarrhea	78	73	67	91	73	4
Tonsilitis	68	69	71	73	70	5
Bronchitis	71	64	68	72	73	6
Consump., Pul.	72	58	63	80	69	7
Remitt'nt Fever	70	45	53	70	60	8
Dysentery	47	44	28	73	40	9
Erysipelas	40	42	36	50	51	10
Typho-mal. F.	59	39	36	57	41	11
Influenza	46	37	43	50	48	12
Infl. of Bowels	30	34	32	34	35	13
Cholera Infant.	27	31	17	42	27	14
Typhoid Fever	35	29	23	40	36	15
Cholera Morbus	33	28	24	55	31	16
Infl. of Kidney	...	28	38	42	...	17
Pneumonia	39	27	33	43	44	18
Whooping-cough	27	26	22	23	23	19
Diphtheria	42	25	34	30	31	20
Scarlatina	27	20	22	18	26	21
Mem. Croup	14	19	8	15	11	22
Puerperal Fever	12	13	10	14	11	23
Cer.-spi. Men.	10	8	8	11	11	24
Inflam. of Brain	10	8	10	11	9	25
Measles	8	8	2	7	18	26
Small-pox	0.7	1	0	0	0	27
Observers.....§	82	118	133	74	88	

November.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	Line Number.
Average.....†	41	36	38	42	42	
Rheumatism	84	86	83	83	78	1
Neuralgia	83	83	82	87	78	2
Bronchitis	79	74	72	79	75	3
Tonsilitis	76	71	80	79	75	4
Intermit. Fever	82	64	69	74	75	5
Consump., Pul.	72	63	65	67	70	6
Diarrhea	56	57	53	67	58	7
Influenza	56	51	51	51	53	8
Remit'nt Fever	63	46	55	58	55	9
Pneumonia	55	43	39	45	57	10
Erysipelas	40	40	45	45	45	11
Typho-mal. F.	46	35	34	45	40	12
Infl. of Kidney	...	33	32	38	...	13
Diphtheria	44	28	32	33	34	14
Whoop.-cough	27	27	21	19	22	15
Dysentery	23	25	20	33	30	16
Infl. of Bowels	27	24	28	27	30	17
Typhoid Fever	31	22	28	33	23	18
Mem. Croup	20	21	11	21	16	19
Scarlatina	28	16	21	17	34	20
Cholera Morbus	15	13	15	24	16	21
Cholera Infant.	10	12	8	18	12	22
Measles	10	10	6	6	22	23
Puerperal Fever	12	10	12	12	13	24
Infl. of Brain	11	8	11	14	16	25
Cer.-spi. Men.	7	7	5	9	10	26
Small-pox	1	1	0	0	0	27
Observers.....§	84	112	130	78	77	

December.* Diseases.	Av. '77-'86.	1886.	1885.	1884.	1883.	Line Number.
Average.....†	41	38	39	44	39	
Neuralgia	85	89	87	90	79	1
Rheumatism	86	88	86	90	84	2
Tonsilitis	81	85	83	82	69	3
Bronchitis	83	78	80	83	76	4
Pneumonia	68	66	52	61	65	5
Consump., Pul.	71	62	67	69	69	6
Intermit. Fever	76	61	68	74	75	7
Influenza	61	54	55	64	63	8
Diarrhea	47	52	55	60	48	9
Erysipelas	43	44	54	45	37	10
Remit'nt Fever	57	41	50	64	45	11
Infl. of Kidney	...	39	34	42	...	12
Infl. of Bowels	28	34	34	34	25	13
Diphtheria	44	29	33	38	25	14
Typho-mal. F.	35	28	23	39	27	15
Whoop.-cough	27	25	23	25	27	16
Scarlatina	32	23	21	30	27	17
Mem. Croup	22	22	10	27	15	18
Typhoid Fever	24	18	14	23	20	19
Infl. of Brain	12	17	16	9	13	20
Dysentery	15	15	15	19	19	21
Puerperal Fever	11	14	17	17	17	22
Cholera Morbus	13	13	12	23	19	23
Measles	14	11	8	6	35	24
Cer.-spi. Men.	8	8	8	14	5	25
Cholera Infant.	5	6	6	10	7	26
Small-pox	2	1	0	0	0	27
Observers.....§	83	105	121	77	75	

*, †, ‡. See notes with these marks on page 122.

§ For this foot-note see page 122.

TABLE 2.—Weekly Reports of Diseases in Michigan in 1886.—*Exhibiting for the Year and for each Month of the Year ending Saturday, January 1, 1887, a Summary relative to Diseases in the State of Michigan; also for each Month a Summary relative to Diseases in each of 11 Geographical Divisions* of the State,—Indicating the Prevalence as regards Time and Area. Compiled from 5,583 Weekly Reports by 169 Observers, Health Officers of Cities and Villages, Regular Correspondents of the State Board of Health, and other Physicians, Reporting the Diseases under their observation.*

Number of Observers, Reports, Etc.	Diseases.	(Av.b) Per Cent of Observers Reporting Presence of.	Average Per Cent of Weeks Reported Present where Present.c	Per Cent of Reports Stating Presence of.d	Average Order of Prevalence where Present.e	Average Order of Prevalence where Present.									
						1885.	1884.	1883.	1882.	1881.	1880.	1879.	1878.	1877.	Av. 1877-1886.
Year Ending January 1, 1887.† Average number of Localities represented, 143. Whole number of Observers during the year, 169. Average per month, 113. Total number of reports compiled, 5,583. Per Month, 465.	Av. for tabulated diseases reported pres,	37	68	26	3.7	3.8	4.2	4.2	4.2	4.9	4.7	4.7	4.4	4.1	.....
	Brain, Inflammation of	13	42	5	5.9	6.0	6.4	6.6	6.6	8.7	8.1	.....	.....	.....	.....
	Bowels, Inflammation of	32	52	17	5.0	5.1	5.8	6.1	6.0	7.4	7.0	.....	.....	.....	.....
	Bronchitis	71	79	56	3.0	3.1	3.2	3.2	3.3	3.9	3.7	3.6	3.3	2.3	3.3
	Cerebro-Spinal Meningitis	8	42	4	7.3	6.9	6.9	7.4	7.2	7.9	7.1	7.4	5.9	6.0	7.0
	Cholera Infantum	25	57	14	3.9	4.6	4.8	4.8	4.9	5.1	5.2	5.4	5.7	4.9	4.9
	Cholera Morbus	29	58	17	4.2	4.5	4.9	5.0	5.2	5.3	5.3	5.3	5.7	4.7	5.0
	Consumption, Pulmonary	64	86	55	3.9	4.0	4.3	4.5	4.6	5.6	5.7	5.6	5.2	5.1	4.9
	Croup, Membranous	12	42	5	6.2	6.1	7.1	7.1	7.0	8.2	7.4	6.6	7.1	6.1	6.9
	Diphtheria	24	53	13	4.2	4.7	5.1	5.4	4.8	5.6	5.7	5.4	5.4	5.3	5.2
	Diarrhea	64	70	45	3.2	3.3	3.3	3.7	3.8	3.9	4.2	4.4	4.2	3.8	3.8
	Dysentery	30	58	17	4.5	5.0	5.0	5.2	5.3	5.1	5.8	6.2	5.9	4.9	5.3
	Erysipelas	43	53	23	4.5	4.6	5.2	5.5	5.5	6.2	6.3	6.5	6.4	5.8	5.7
	Fever, Intermittent	71	76	54	2.6	2.4	2.5	2.3	2.0	2.4	2.3	2.2	2.1	2.2	2.3
	Fever, Remittent	48	69	34	3.3	3.2	3.3	3.3	3.3	3.5	3.3	3.3	3.1	3.1	3.3
	Fever, Typhoid (Enteric)	15	55	8	4.7	4.7	5.2	5.1	5.1	6.2	6.5	7.0	7.0	5.5	5.7
	Fever, Typho-Malarial	27	58	16	4.2	4.4	4.6	4.8	4.9	5.2	5.5	5.8	5.4	4.7	5.0

For the Whole number of Localities sented per month, 104. age number of observers Average No. of Reports															
	Influenza	48	73	35	2.7	2.9	3.3	3.2	3.1	3.5	3.0	3.1	3.1	3.0	3.1
	Kidney, Inflammation of	35	57	20	4.7	4.4	5.0								
	Measles	10	54	6	5.0	6.4	5.2	3.7	4.9	4.4	4.8	4.7	5.3	5.0	4.9
	Neuralgia	83	81	67	2.8	2.8	3.3	3.3	3.6	4.3	4.5	4.5			
	Pneumonia	48	56	27	4.0	4.4	4.5	4.7	4.4	5.4	5.1	5.2	4.8	4.0	4.7
	Puerperal Fever	12	41	5	5.9	6.3	6.9	7.3	6.2	8.2	7.8	7.2	6.3	6.1	6.8
	Rheumatism	85	82	70	3.2	3.2	3.6	3.7	3 8	4.6	4.6	4.6	4.2	4.0	4.0
	Scarlatina	20	55	11	4.5	5.0	5 2	5.2	4.9	6.7	6.5	5.5	5.4	4.8	5.4
	Small-pox	0.5	71	0.4	25.9	8.4	26.0	14.0	9.1	8.9	6.3	10.6	3.9	6.8	12.0
	Tonsilitis	70	69	49	3.4	3.5	3.7	3.9	3.9	4.5	4.4	4.5			
	Whooping-cough	28	70	20	3.7	4.1	4.5	5.2	4.4	6.3	5.5	4.7	4.8	5.1	4.8

* For Counties in each Division, see Exhibit I., page 111.

† For number of Observers, reports, weeks in each month, etc., see Exhibit III., page 114; for names of observers, and number of reports received from each, see Exhibit V., pages 118-120.

a Not every one of the observers sent in a report for every week, so that the number of reports received does not equal the number of observers multiplied by the number of weeks.

b The numbers in this column (pages 124-125) state not what per cent of the whole number of observers for the year reported the disease present at some time during the year, but the average (for the twelve months) of the per cents (of observers making reports for the several months) by which the disease was reported present in those months. The column for the year is thus a statement for an average *month*. But on pages 126 and 127 the numbers in the "Per Cent of Observers" column are statements for the month, and not averages. This column indicates the Area of Prevalence, except that in a few instances there were two or more observers in one city or village.

c This column states for the year or given month what per cent the number of reports which stated a disease to be present is of the number of card-reports received, for the given time, from such of the observers as reported the disease present. It is therefore an average not for all localities represented, but only for those at which the given disease was reported present. In the line "Average for Tabulated Diseases" it states what per cent the number of times *all* diseases were reported present is of the number of times they *might have been* so reported on the cards received, for the time specified, from the observers who during that time reported the diseases present (that is, if each of the observers had on every card he sent reported every disease present which he reported present at all). It will be seen that this is a more accurate average than would be obtained by dividing the sum of the column by the number of diseases reported present.

d This column states what per cent the number of reports stating presence of a disease is of the whole number of reports received for the time specified, from *all observers* in the State or Division, as the case may be. It combines, and states in a general way, an idea of the *time* a disease was prevalent, with an idea of the area of its prevalence. Had every observer sent a report every week of the month or year, the numbers in this column would be (for the State) the product of the numbers in the same line in the two preceding columns.

e The disease having the greatest number of cases was to be marked 1 in the order; the disease having the next greatest number of cases, 2; and so on. Diseases not present were to be marked 0. The numbers in this column are found by dividing the totals (for the State) of the Order of Prevalence column, in Table 3 (a table giving statements for each locality, omitted in printing this Report, for want of room), by the number of men who reported the disease present. The column is, therefore, an average not for all the localities represented, but only for those at which the given disease was reported present. The numbers in the "Average" lines for this column are found by dividing the sum of the totals in the Order of Prevalence columns, in Table 3, for all diseases reported present, by the sum of the numbers of men who reported the different diseases present, thus counting each man once for every disease he reported present. As a rule, small numbers in this column indicate a large prevalence of the disease, and *vice versa*; but the greater the number of diseases reported present by each observer from week to week, the greater will be the "average" in this column.

TABLE 2.—CONTINUED.—*Diseases in the State, 1886.* (*For foot-notes and full tabular heads, see pages 124-5.*)

Diseases.	January.†				February.†				March.†				April.†				May.†				June.†			
Months.†	Per ct. of Observers Reporting Pres. of. b	Av. per ct. of Weeks Reported Present where Present. a,c	Per cent of Reports Stating Pres. of. d	Av. Order of Prevalence where Pres. e	Per ct. of Observers Reporting Pres. of. b	Av. per ct. of Weeks Reported Present where Present. a,c	Per cent of Reports Stating Pres. of. d	Av. Order of Prevalence where Pres. e	Per ct. of Observers Reporting Pres. of. b	Av. per ct. of Weeks Reported Present where Present. a,c	Per cent of Reports Stating Pres. of. d	Av. Order of Prevalence where Pres. e	Per ct. of Observers Reporting Pres. of. d	Av. per ct. of Weeks Reported Present where Present. a,c	Per cent of Reports stating Pres. of. d.	Av. Order of Prevalence where Pres. e	Per ct. of Observers Reporting Pres. of b	Av. per ct. of Weeks Reported Present where Present. a,c	Per cent of Reports Stating Pres. of. d	Av. Order of Prevalence where Pres. e	Per. ct. of Observers Reporting Pres. of. b	Av. per ct. of Weeks Reported Present where Present. a,c	Per cent of Reports Stating Pres. of. d	Av. Order of Prevalance where Pres. e
Av. for Tab. Dis. Rep. Pres.	37	71	26	3.8	37	71	26	3.7	41	68	28	3.9	38	72	27	3.7	37	70	26	3.8	37	63	23	3.5
Brain, Inflammation of	14	55	7	6.1	12	48	5	6.4	16	35	6	5.7	17	39	7	5.6	11	44	5	6.8	16	44	7	4.8
Bowels, Inflammation of	26	61	16	6.0	28	53	15	5.5	31	49	15	4.9	27	47	13	4.9	36	52	19	5.3	32	56	18	4.8
Bronchitis	81	88	71	2.5	82	85	69	2.6	86	82	71	2.6	82	81	65	2.8	73	78	57	2.9	69	65	45	3.0
Cerebro-spinal Meningitis	8	53	4	8.0	10	43	4	6.8	17	39	7	6.9	8	47	4	7.5	7	46	3	8.3	5	40	2	8.4
Cholera Infantum	3	50	1	6.3	2	38	1	7.0	6	34	2	7.0	5	47	2	5.2	12	39	5	6 3	27	38	10	4.7
Cholera Morbus	10	34	3	7.0	4	53	2	4.0	12	28	3	7.3	11	42	5	6.3	15	56	8	5.2	27	46	12	4.6
Consumption, Pulmonary	68	89	61	4.0	66	87	58	4.1	72	83	60	4.1	69	88	61	3.9	68	88	60	3.8	65	85	55	3.4
Croup, Membranous	16	44	7	6.1	13	44	6	4.5	11	35	4	5.5	7	48	3	5.9	10	34	4	6.8	8	44	4	6.1
Diphtheria	33	54	18	4.2	27	54	14	4.2	25	43	11	5.2	21	57	12	3.9	25	45	12	4.7	18	49	9	3.2
Diarrhea	45	61	27	4.3	48	64	31	4.6	46	55	25	4.9	51	61	31	4.2	52	73	38	3.9	67	59	40	3.3
Dysentery	13	40	5	5.6	13	56	8	6.4	16	44	7	5.9	12	53	7	5.3	18	52	10	6.0	17	56	10	5.4
Erysipelas	47	54	25	5.0	39	63	25	4.8	44	58	26	5.3	48	66	31	4.4	51	54	28	4.1	42	56	24	3.9
Eever, Intermittent	61	76	47	3.2	66	75	49	3.2	71	71	50	3.1	74	83	61	2.7	70	81	57	2.6	79	77	61	2.0
Fever, Remittent	50	67	33	3.8	43	67	29	3.8	48	71	34	3.9	49	69	34	3.6	48	73	35	3.5	54	65	36	2.7
Fever, Typhoid (Enteric)	8	70	6	6.6	7	50	3	6.8	9	49	4	6.0	5	55	3	7.0	7	67	5	5.4	7	45	4	6.1
Fever, Typho-malarial	18	57	10	4.8	15	61	9	4.6	25	48	12	4.5	18	54	9	4.7	20	55	11	4.3	20	50	10	4.5
Influenza	55	80	44	2.4	63	80	51	2.1	78	79	62	1.8	72	75	54	2.2	45	77	35	2.8	42	61	26	2.9
Kidney, Inflammation of	34	64	21	4.6	37	51	19	4.8	41	50	21	5.5	40	67	25	4.9	36	65	24	4.8	40	48	19	4.6
Measles	7	56	4	5.8	9	57	5	5.2	13	46	6	5.2	9	69	5	3.6	17	60	11	3.7	15	48	7	4.7
Neuralgia	85	82	69	2.6	82	85	69	2.6	89	83	74	2.7	85	87	74	2.8	83	85	71	2.6	79	80	63	2.4
Pneumonia	62	59	37	3.9	68	67	46	3.7	80	64	52	3.8	67	61	41	3.9	51	55	29	4.1	43	43	19	3.7
Puerperal Fever	12	46	6	6.1	12	43	5	7.1	18	33	6	5.5	18	40	7	5.9	10	53	5	7.2	15	35	5	5.5
Rheumatism	86	80	68	2.9	85	83	71	2.9	88	89	78	3.2	89	86	76	3.1	86	86	74	3.0	86	81	70	2.9

	July.†				August.†				September.†				October.†				November.†				December.†			
Tonsilitis	78	79	62	3.2	83	76	63	3.1	83	76	63	3.4	71	77	54	3.4	63	69	44	3.5	64	61	39	3.5
Whooping-cough	22	71	16	3.6	22	76	17	3.3	23	71	17	3.9	21	71	15	3.9	32	70	23	3.6	31	71	23	3.7
Av. for Tab. Dis. Rep. Pres.	38	66	25	3.5	39	70	27	3.8	42	65	28	3.8	38	67	25	3.6	36	69	25	3.7	38	65	25	3.8
Brain, Inflammation of	14	41	6	5.5	13	47	6	5.8	11	39	4	7.3	8	41	4	6.4	8	55	4	6.9	17	33	6	4.8
Bowels, Inflammation of	35	57	20	4.3	37	56	21	5.1	40	49	20	5.0	34	51	17	4.4	24	51	12	4.9	34	46	16	4.8
Bronchits	56	73	40	3.7	54	68	37	3.9	54	75	41	4.0	64	78	51	3.2	74	83	61	2.8	78	83	65	2.7
Cerebro-spinal Meningitis	11	35	4	6.0	6	42	2	8.9	8	30	2	7.4	8	54	4	6.6	7	42	3	6.4	8	45	4	8.0
Cholera Infantum	49	59	29	3.6	68	69	47	3.1	69	61	42	3.4	31	57	17	4.4	12	43	5	6.4	6	41	2	3.8
Cholera Morbus	68	61	41	3.5	68	79	54	3.5	66	61	40	3.6	28	48	13	3.9	13	42	6	5.6	13	33	5	5.4
Consumption, Pulmonary	58	88	51	3.6	59	86	52	4.2	57	84	48	4.1	58	86	51	3.7	63	87	55	3.7	62	86	54	3.8
Croup, Membranous	5	48	2	7.3	6	46	3	8.1	11	45	5	6 8	19	45	8	6.3	21	42	9	6.4	22	36	8	5.8
Diphtheria	16	61	10	3.9	18	56	10	4.4	23	45	10	4.4	25	68	17	3.7	28	63	18	4.0	29	52	15	4.5
Diarrhea	87	76	66	2.3	94	87	82	1.8	92	88	81	1.9	73	70	51	2.7	57	63	36	3.8	52	52	27	4.0
Dysentery	43	58	24	4.1	65	68	44	3.7	69	62	43	3.6	44	58	25	4.0	25	48	12	4.7	15	43	7	6.6
Erysipelas	41	49	20	3.9	38	48	18	4.9	40	44	18	4.6	42	50	21	3.7	40	51	20	4.3	44	45	20	5.0
Fever, Intermittent	79	78	61	2.3	76	78	60	2.5	77	74	58	2.6	76	74	57	2.3	64	75	48	2.7	61	67	41	2.9
Fever, Remittent	53	69	36	2.9	47	74	36	3.3	55	66	36	3.0	45	73	33	2.8	46	73	34	3.4	41	65	27	3.7
Fever, Typhoid (Enteric)	12	47	5	4.9	24	53	13	4.1	29	55	16	4.2	29	59	16	3.8	22	62	13	4.6	18	52	10	4.6
Fever, Typho-malarial	27	53	14	4.2	30	58	18	4.2	44	61	27	4.1	39	65	25	3.8	35	68	24	3.8	28	54	15	3.8
Influenza	25	56	14	4.3	20	51	10	4.9	34	61	21	3.8	37	70	27	3.1	51	71	36	2.8	54	78	42	2.8
Kidney, Inflammation of	33	57	19	4.3	30	60	18	4.6	26	58	15	5.5	28	64	18	4.6	33	52	17	4.4	39	56	22	4.5
Measles	8	54	4	6.0	9	50	4	6.4	9	45	4	5.9	8	58	4	4.6	10	55	5	4.6	11	61	7	5.3
Neuralgia	81	77	63	2.9	75	80	60	3.3	83	74	61	3.4	81	78	63	2.7	83	81	67	2.7	89	82	73	2.6
Pneumonia	21	51	11	4.2	22	44	10	4.8	27	45	12	4.8	27	47	13	4.7	43	51	22	4.4	66	56	37	4.1
Puerperal Fever	8	50	4	6.6	11	40	5	5.9	10	41	4	5.6	13	49	6	5.0	10	46	4	5.6	14	31	5	5.8
Rheumatism	82	76	63	3.1	76	82	62	3.7	84	78	65	3.7	86	79	69	3.2	86	84	72	3.1	88	83	73	3.0
Scarlatina	12	60	7	4.7	13	47	6	5.1	15	43	7	4.6	20	57	12	3.8	16	54	9	5.7	23	53	13	4.8
Small-pox	1	100	1	26 0	0.8	100	1	26.0	0.9	60	0.5	26.0	1	100	0.9	26.0	1	75	0.7	26 0	1	40	0.4	25.0
Tonsilitis	55	59	32	3.8	52	59	31	4.2	65	60	39	4.0	69	64	44	3.4	71	74	52	3.1	85	72	61	2.8
Whooping-cough	34	71	23	3.4	37	70	26	3.7	36	65	24	3.6	26	74	20	4.1	27	71	19	4.1	25	58	14	3.7

TABLE 2.—CONTINUED.—*Diseases in the Upper Peninsular, the Northwestern, the Northern, and the Northeastern Divisions of the State for the Years 1877–1886, and by Months in 1886.—Indicating what Per Cent of the Weekly Reports Received Stated the Presence of the Diseases Named.*[d]

Div.*	Diseases.	'77-'86.‡	1886.†	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Div.*	'77-'86.‡	1886.†	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	Av. for Tab. Dis. Rep. Pres....	30	27	39	45	48	44	36	33	37	40	28	37	27	27		33	31	80	88	68	88	88	53	46	57	38	33	38	40
Upper Peninsular Division.*	Brain, Inflammation of.....	7	13	64	0	0	10	17	0	27	17	0	0	17	16	Northwestern Division.*	3	1	0	0	0	0	0	0	0	0	0	0	0	10
	Bowels, Inflammation of.....	20	15	9	33	36	10	33	25	9	8	0	18	0	5		8	4	0	50	0	0	0	13	0	0	0	0	0	0
	Bronchitis	72	70	91	92	100	100	75	33	36	58	64	64	61	68		60	56	100	100	100	100	100	75	57	17	10	17	43	50
	Cerebro-spinal Meningitis	3	7	18	8	0	10	0	0	0	17	7	27	0	5		3	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cholera Infantum.....	13	12	0	0	0	0	0	17	45	50	36	0	6	0		23	23	0	0	20	50	0	0	43	67	50	33	0	0
	Cholera Morbus.....	17	17	9	0	0	0	25	33	55	50	7	0	11	16		23	20	25	0	0	25	0	0	14	67	50	33	0	10
	Consumption, Pulmonary.....	75	69	100	100	100	100	58	83	55	50	36	73	56	47		40	67	100	100	100	100	100	63	57	67	50	33	43	60
	Croup, Membranous.....	6	11	18	25	0	0	25	25	0	8	7	0	11	11		8	5	25	0	0	0	0	0	0	0	0	0	0	30
	Diphtheria.....	9	15	18	25	29	30	17	0	0	0	0	0	32	26		17	7	0	50	20	0	50	0	0	0	0	0	0	0
	Diarrhea.....	60	54	64	67	36	50	75	50	73	67	64	27	44	42		60	60	100	100	40	100	100	63	57	83	60	33	43	20
	Dysentery.....	26	26	18	50	14	0	50	33	45	67	21	27	6	5		31	31	25	50	0	0	0	0	71	83	50	33	29	10
	Erysipelas.....	24	15	45	33	14	30	17	0	18	0	7	0	11	11		34	17	75	0	20	0	0	0	0	50	30	0	0	30
	Fever, Intermittent.....	9	14	18	8	7	20	0	0	18	33	14	27	22	5		79	65	100	100	100	100	100	63	57	67	50	33	43	50
	Fever, Remittent.....	15	11	27	25	7	20	25	25	0	0	7	0	6	0		41	67	100	100	100	100	100	63	71	67	50	33	43	50
	Fever, Typhoid (Enteric).....	29	15	0	8	36	10	0	8	9	8	0	0	33	42		9	5	0	0	0	0	0	0	14	0	10	33	0	0
	Fever, Typho-malarial.....	5	10	0	0	0	0	25	8	18	0	7	9	17	21		30	16	0	0	0	0	50	0	0	0	80	33	0	0
	Influenza	49	37	55	58	71	70	42	50	0	0	21	36	28	26		48	48	100	100	80	100	100	63	43	17	0	0	43	40
	Kidney, Inflammation of.....	55	50	27	42	79	90	42	50	73	67	36	36	28	47		35	8	0	0	0	0	0	38	0	0	0	0	0	30
	Measles	17	10	9	33	7	20	42	17	0	0	0	0	6	0		15	9	0	0	40	0	0	25	0	0	0	0	0	30
	Neuralgia.....	45	58	73	67	71	70	42	50	55	58	79	45	61	37		73	68	100	100	100	100	100	63	57	67	40	33	43	80
	Pneumonia.....	40	33	27	58	93	60	42	58	0	25	0	0	11	26		39	48	100	100	80	75	100	75	29	17	10	0	29	50
	Puerperal Fever.....	5	3	0	0	0	20	8	0	0	0	0	0	0	5		5	5	50	0	0	0	0	13	0	0	10	0	0	0
	Rheumatism.....	65	56	55	75	86	70	58	25	27	58	43	82	56	47		73	71	100	100	100	100	100	63	57	67	50	50	43	80
	Scarlatina.....	28	8	9	0	29	10	17	8	0	0	0	0	0	21		23	12	0	0	20	0	50	0	0	0	30	0	43	0
	Small-pox.....	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0		1	0	0	0	0	0	0	0	0	0	0	0	0	0

Northern Division.*															Northeastern Division.*													
Tonsilitis	30	45	64	58	64	50	33	35	36	42	7	9	39	47	59	59	100	100	100	100	100	63	57	67	10	33	29	50
Whooping-cough	25	34	36	33	36	40	25	25	0	33	36	36	39	53	20	3	0	0	0	0	0	0	0	0	0	0	29	0
Av. for Tab. Dis. Rep. Pres.	18	10	28	23	25	40	33	28	15	20	20	22	27	16	30	26	35	40	37	46	41	28	39	42	40	35	38	39
Brain, Inflammation of	3	4	0	0	0	0	0	29	0	14	0	0	0	0	4	6	17	0	7	0	0	21	9	10	7	0	0	7
Bowels, Inflammation of	3	2	0	0	0	0	0	7	19	0	0	0	0	0	23	20	17	33	21	0	0	14	36	10	29	13	25	33
Bronchitis	45	15	50	50	44	0	0	0	0	0	0	0	0	0	84	85	100	83	93	92	92	57	36	70	100	93	94	100
Cerebro-spinal Meningitis	2	2	0	0	11	0	0	0	6	0	0	0	0	0	4	3	17	0	7	0	0	7	0	10	0	0	0	0
Cholera Infantum	5	6	0	0	0	0	0	0	13	43	7	0	0	0	11	10	0	0	0	0	0	7	9	20	29	20	19	13
Cholera Morbus	3	1	6	0	0	0	0	0	6	0	0	0	0	0	14	10	0	0	0	0	0	14	18	30	50	7	0	0
Consumption, Pulmonary	16	19	50	44	44	0	0	21	6	7	7	0	0	13	65	47	42	58	36	50	33	29	36	50	64	53	50	60
Croup, Membranous	1	1	0	6	0	0	0	0	0	0	0	8	0	0	10	7	8	8	14	0	8	0	0	0	14	20	6	0
Diphtheria	9	4	25	0	0	0	0	0	0	0	7	0	0	7	12	23	17	25	36	17	0	29	27	50	29	7	25	20
Diarrhea	36	14	0	0	11	25	0	21	38	29	43	0	0	0	67	54	8	42	21	33	42	29	82	100	100	73	69	53
Dysentery	21	7	6	19	0	0	0	0	6	43	0	0	0	0	27	26	8	17	29	0	0	14	73	90	64	20	19	0
Erysipelas	8	7	6	19	0	0	13	29	0	0	7	8	10	0	24	20	8	25	21	42	33	14	18	10	7	20	13	33
Fever, Intermittent	27	31	13	38	28	25	50	43	19	29	43	42	30	27	19	27	33	17	29	42	33	36	27	30	21	33	13	13
Fever, Remittent	4	2	0	6	11	0	0	0	0	0	0	0	0	7	25	8	0	0	14	17	0	7	0	0	14	7	19	7
Fever, Typhoid (Enteric)	11	16	19	0	0	0	0	0	6	21	36	33	40	40	4	3	0	0	0	0	0	0	0	0	21	13	0	0
Fever, Typho-malarial	10	6	0	0	6	0	0	0	13	29	0	8	0	7	10	6	0	8	7	0	0	7	0	10	7	27	0	0
Influenza	29	4	0	6	22	13	13	0	0	0	0	0	0	0	31	36	42	42	36	58	50	43	0	30	29	40	31	33
Kidney, Inflammation of	7	1	0	6	0	0	0	0	0	0	0	0	0	0	38	15	17	8	14	17	0	7	18	30	0	20	19	33
Measles	11	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2	17	0	0	0	0	0	0	0	0	0	0	7
Neuralgia	53	16	31	31	44	0	0	14	6	14	14	0	0	7	89	90	100	92	93	100	100	86	91	80	93	73	81	100
Pneumonia	23	25	28	6	39	88	75	43	25	7	7	8	0	0	37	35	50	50	64	42	17	7	18	50	21	40	31	33
Puerperal Fever	8	2	0	0	6	0	0	0	0	0	0	0	10	7	4	1	0	0	0	0	0	7	0	0	0	0	0	0
Rheumatism	58	29	63	38	28	0	0	36	38	14	36	17	30	20	81	78	67	75	100	58	67	79	82	80	93	93	56	80
Scarlatina	4	2	0	0	0	0	0	0	0	7	14	0	0	7	8	3	0	0	0	0	0	0	0	0	7	13	0	1
Small-pox	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tonsilitis	28	32	31	31	44	50	38	36	6	7	14	50	40	47	73	62	75	58	57	42	33	64	45	70	79	47	75	87
Whooping-cough	10	8	25	25	17	0	13	0	0	0	0	0	0	7	6	6	17	0	0	0	8	0	36	10	7	0	0	7

*, †, d. See page 125. ‡ Inflammation of kidney was not compiled until 1884. For inflammation of brain and inflammation of bowels, an average for the seven years 1880-86; for neuralgia and tonsilitis, an average for the eight years 1879-86; for other diseases, and for the average line, an average for the ten years 1877-86. For the northern division 1882-86. For the northeastern division 1883-86.

TABLE 2.—CONTINUED.—*Diseases in the Western, Northern Central, Bay and Eastern, and the Central Divisions of the State, for the Years 1877-1886, and by Months in 1886, indicating what Per Cent of the Weekly Reports Received Stated the Presence of the Diseases Named.*[d]

Div.†	Diseases.	'77-'86.‡	1886.†	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
Western Division.*	Av. for Tab. Dis. Rep. Pr	32	29	35	33	30	33	30	27	31	23	33	30	26	31
	Brain, Inflammation of	4	4	2	7	0	6	0	10	2	4	6	6	2	4
	Bowels, Inflammation of	17	25	17	12	13	9	30	31	29	42	37	29	25	24
	Bronchitis	55	55	52	57	60	66	64	50	37	36	44	51	67	78
	Cerebro-spinal Meningitis	4	3	0	0	12	6	3	0	5	4	2	2	4	0
	Cholera Infantum	17	18	0	0	0	0	3	12	39	70	48	18	4	2
	Cholera Morbus	21	20	7	5	8	11	9	14	39	64	38	18	6	11
	Consumption, Pulmonary	49	46	45	40	38	46	70	50	39	56	44	43	46	39
	Croup, Membranous	6	6	14	5	6	9	3	5	0	2	2	4	6	15
	Diphtheria	27	10	21	21	10	0	3	7	0	0	13	12	10	15
	Diarrhea	47	48	24	33	25	31	36	45	66	94	87	55	33	30
	Dysentery	26	18	0	0	2	6	15	10	27	66	48	25	4	2
	Erysipelas	30	29	29	36	40	34	45	33	34	28	27	22	13	20
	Fever, Intermittent	75	66	74	76	54	74	52	55	78	78	68	71	51	59
	Fever, Remittent	65	47	60	57	50	54	36	33	49	54	56	47	42	26
	Fever, Typhoid (Enteric)	11	7	0	0	4	0	0	5	10	20	14	20	4	0
	Fever, Typho-malarial	26	22	17	7	13	29	24	21	24	26	29	29	25	15
	Influenza	47	47	62	62	67	54	33	38	32	22	30	45	54	61
	Kidney, Inflammation of	17	13	26	26	17	9	12	14	10	6	5	14	4	19
	Measles	13	8	0	2	2	0	12	2	5	10	10	16	13	20
	Neuralgia	72	79	71	83	81	91	82	81	61	74	75	78	77	91
	Pneumonia	39	24	33	43	42	34	27	14	15	6	11	4	33	35
	Puerperal Fever	7	5	14	10	4	6	3	5	2	4	5	6	2	6
	Rheumatism	62	69	69	57	79	69	67	64	49	76	67	73	75	80
	Scarlatina	25	10	24	17	17	11	6	0	0	2	2	25	4	13
	Small-pox	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Div.†	Diseases.	'77-'86.‡	1886.†	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
Northern Central Division.*	Av. for Tab. Dis. Rep. Pr	29	22	45	56	44	93	39	44	32	32	24	19	20	24
	Brain, Inflammation of	3	1	0	0	0	0	0	11	0	0	0	0	0	0
	Bowels, Inflammation of	5	7	0	0	0	0	13	28	12	0	6	5	0	8
	Bronchitis	52	40	63	63	70	100	80	72	35	24	15	21	39	25
	Cerebro-spinal Meningitis	9	2	0	0	0	0	0	0	0	4	3	5	6	0
	Cholera Infantum	12	19	0	0	0	0	27	11	29	48	44	0	0	0
	Cholera Morbus	17	18	0	25	0	0	7	0	35	48	29	21	0	4
	Consumption, Pulmonary	36	28	88	50	50	75	40	33	35	28	15	5	6	17
	Croup, Membranous	10	4	0	0	20	0	0	6	0	0	3	5	6	4
	Diphtheria	31	11	13	0	0	0	0	0	24	20	12	11	6	21
	Diarrhea	48	47	13	25	50	100	47	61	47	72	68	32	33	8
	Dysentery	18	21	0	0	0	0	27	22	35	48	32	11	11	0
	Erysipelas	31	22	38	25	50	75	33	39	12	20	6	16	11	17
	Fever, Intermittent	69	62	50	88	70	100	67	100	88	64	56	42	44	33
	Fever, Remittent	56	39	50	50	50	100	53	61	29	36	32	26	28	25
	Fever, Typhoid (Enteric)	10	6	25	0	0	0	7	11	0	12	6	5	0	0
	Fever, Typho-malarial	31	22	25	0	20	0	27	61	18	12	38	16	6	8
	Influenza	11	6	0	0	0	0	13	0	0	4	3	16	6	17
	Kidney, Inflammation of	7	13	0	0	20	0	40	44	18	4	0	11	6	13
	Measles	16	1	0	0	0	0	0	0	6	0	0	0	0	0
	Neuralgia	56	54	63	88	80	100	80	72	59	48	35	42	39	38
	Pneumonia	32	20	13	75	40	75	40	22	6	0	3	5	11	42
	Puerperal Fever	4	2	0	0	10	0	20	0	0	0	0	0	0	0
	Rheumatism	59	62	50	38	50	100	73	94	71	60	59	53	44	63
	Scarlatina	8	1	0	0	10	0	0	0	0	0	0	0	0	0
	Small-pox	1	0	0	0	0	0	0	0	0	0	0	0	0	0

	Tonsilitis	55	59	64	69	71	71	64	38	56	50	59	49	50	69		59	53	100	88	70	100	60	72	41	32	35	42	50	58
	Whooping-cough	16	22	10	10	15	9	24	14	15	42	44	25	21	22		15	11	0	0	0	0	20	22	12	20	12	11	11	0
Bay and Eastern Division.*	Av. for Tab. Dis. Rep. Pr.	34	25	25	23	26	26	23	23	25	26	29	27	31	27	Central Division.*	27	27	27	29	30	32	28	25	28	29	30	28	25	26
	Brain, Inflammation of	7	4	5	1	9	7	5	1	1	4	1	4	3	2		5	5	6	6	7	3	7	8	7	5	0	0	1	5
	Bowels, Inflammation of	21	18	23	12	9	21	25	14	19	18	18	25	11	18		12	17	15	14	23	16	20	17	23	26	16	15	12	9
	Bronchitis	71	52	61	61	62	67	51	46	43	41	37	46	53	65		53	55	71	72	77	72	57	42	43	27	28	43	62	65
	Cerebro-spinal Meningitis	6	2	5	4	1	4	3	0	3	0	0	0	0	5		4	4	4	4	6	0	7	2	5	1	1	10	6	1
	Cholera Infantum	18	16	2	0	0	2	2	11	33	49	54	25	6	2		11	13	0	0	2	2	1	8	24	44	44	22	5	0
	Cholera Morbus	21	18	0	0	0	2	17	28	41	51	53	13	6	0		15	13	6	0	2	2	0	2	40	57	40	8	3	1
	Consumption, Pulmonary	69	52	53	51	53	54	52	50	41	46	54	54	61	59		60	54	52	47	57	59	58	59	57	52	41	47	56	62
	Croup, Membranous	10	4	3	1	4	2	3	4	3	1	0	6	14	7		3	2	1	2	2	0	1	0	0	0	1	6	6	3
	Diphtheria	29	15	25	17	16	21	16	11	4	13	5	15	23	21		22	12	17	17	8	22	13	7	17	12	3	16	16	1
	Diarrhea	51	42	27	20	16	28	30	33	62	87	83	54	31	23		42	45	31	34	29	34	39	42	67	89	84	44	27	18
	Dysentery	20	16	8	7	9	11	6	8	19	38	33	28	8	7		15	17	3	2	5	3	3	8	23	52	54	25	16	4
	Erysipelas	25	15	8	7	7	18	17	20	19	18	11	22	25	16		19	27	31	33	41	44	33	20	15	13	13	27	27	28
	Fever, Intermittent	78	55	55	45	57	60	60	64	67	59	55	50	52	43		73	59	42	42	47	67	62	67	66	66	75	65	65	52
	Fever, Remittent	46	24	27	12	28	21	25	29	29	21	20	26	30	21		47	39	35	39	42	38	48	44	49	40	40	32	34	23
	Fever, Typhoid (Enteric)	9	7	2	6	1	2	0	1	4	7	15	15	19	6		12	7	0	1	1	0	4	4	7	15	14	18	16	1
	Fever, Typho-malarial	30	24	8	13	16	12	10	18	28	27	44	29	48	26		19	15	10	4	7	3	10	7	20	24	36	25	25	11
	Influenza	43	34	42	52	62	56	24	18	17	10	18	25	47	40		36	35	39	57	69	52	38	28	9	4	14	18	35	56
	Kidney, Inflammation of	23	19	33	12	11	23	21	16	23	15	15	21	20	23		21	21	16	19	25	33	25	21	20	21	10	19	19	27
	Measles	15	7	6	9	4	0	2	7	7	8	8	4	13	11		10	3	2	2	9	8	7	5	1	1	0	0	4	0
	Neuralgia	71	62	61	59	67	63	65	61	64	54	54	57	67	71		61	70	69	71	75	75	75	59	58	59	66	76	77	90
	Pneumonia	42	26	31	49	50	30	25	22	9	10	2	10	27	44		33	27	37	49	50	38	32	11	9	6	16	15	13	43
	Puerperal Fever	5	4	0	1	7	7	2	3	1	6	2	12	0	4		5	7	7	4	12	11	3	4	15	6	7	6	10	1
	Rheumatism	76	67	61	61	74	81	67	64	54	54	60	72	86	73		61	69	67	73	81	73	83	72	60	61	60	61	61	73
	Scarlatina	19	7	5	7	8	2	8	7	3	7	7	6	11	11		13	3	4	8	8	16	13	22	13	7	2	9	6	4
	Small-pox	1	0	0	0	0	0	0	0	0	0	0	0	0	0		0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tonsilitis	53	37	39	39	45	39	29	25	23	15	31	40	55	61		41	46	65	74	69	52	33	34	30	27	30	37	47	49
	Whooping-cough	26	17	6	4	8	16	19	24	26	28	23	13	27	10		18	18	15	17	22	14	22	19	26	21	22	19	10	5

*, †, ‡. See page 125. ‡ Inflammation of kidney was not compiled until 1884. For inflam. of brain, and inflam. of bowels, an average for the six years 1880-6; for neuralgia and tonsilitis, an av. for the eight years 1879-86; for other diseases, and for the av. line, an av. for the ten years 1877-86.

TABLE 2.—CONTINUED.—*Diseases in the Southwestern and Southern Central Divisions of the State, for the years 1877–1886, and by Months in 1886,—Indicating what Per Cent of the Weekly Reports Received Stated the Presence of the Diseases Named.*[d]

Div.*	Diseases.	'77-86.‡	1886.†	Jan.†	Feb.†	March.†	April.†	May.†	June.†	July.†	Aug.†	Sept.†	Oct.†	Nov.†	Dec.†
Southwestern Division.*	Av. for Tab. Dis. Rep. Pres.	29	26	34	31	35	30	32	25	32	30	30	23	23	23
	Brain, Inflammation of	4	4	0	2	4	11	0	4	13	9	4	0	0	2
	Bowels, Inflammation of	10	13	11	12	6	5	11	10	15	19	22	9	17	13
	Bronchitis	54	55	82	77	69	65	63	40	33	42	42	48	46	53
	Cerebro-spinal Meningitis	2	2	0	0	4	5	0	4	5	0	2	3	0	0
	Cholera Infantum	20	14	0	0	0	3	11	15	28	47	42	18	6	2
	Cholera Morbus	15	16	2	2	2	0	3	8	38	65	48	12	3	2
	Consumption, Pulmonary	73	71	70	70	88	89	82	75	69	72	68	58	57	49
	Croup, Membranous	5	5	11	5	0	3	3	8	0	5	8	3	3	7
	Diphtheria	14	8	7	12	4	19	18	10	0	2	0	9	11	7
	Diarrhea	39	35	11	21	14	14	42	40	59	65	76	39	17	18
	Dysentery	13	13	0	7	0	3	11	10	18	28	40	15	14	9
	Erysipelas	22	26	25	26	31	30	26	35	26	30	28	12	14	18
	Fever, Intermittent	81	58	43	60	53	76	61	69	59	63	56	70	66	31
	Fever, Remittent	50	32	36	28	39	32	34	35	36	40	28	21	20	20
	Fever, Typhoid (Enteric)	6	7	5	0	0	11	13	6	0	12	10	3	11	13
	Fever, Typho-malarial	21	22	18	16	27	19	21	6	15	28	28	55	20	18
	Influenza	44	32	59	60	59	41	26	23	18	9	18	12	20	24
	Kidney, Inflammation of	14	14	18	14	12	14	8	21	15	28	29	9	9	2
	Measles	9	4	0	2	0	5	16	10	0	9	2	3	0	0
	Neuralgia	75	71	73	74	82	86	84	77	77	67	60	52	57	64
	Pneumonia	31	28	48	40	59	46	26	21	8	12	14	12	11	36
	Puerperal Fever	2	4	2	5	4	8	0	0	0	7	6	0	3	9
	Rheumatism	75	75	80	79	86	81	87	71	72	63	80	58	66	71
	Scarlatina	13	8	11	7	6	14	8	2	0	5	4	9	6	29
	Small-pox	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tonsilitis	45	51	75	79	90	68	58	38	28	7	38	30	43	49
	Whooping-cough	15	10	16	26	8	3	16	15	15	9	4	3	0	4

Div.*	Diseases.	'77-86.‡	1886.†	Jan.†	Feb.†	March.†	April.†	May.†	June.†	July.†	Aug.†	Sept.†	Oct.†	Nov.†	Dec.†
Southern Central Division.*	Av. for Tab. Dis. Rep. Pres.	29	28	29	28	30	29	27	28	23	32	31	31	30	29
	Brain, Inflammation of	4	6	10	6	4	6	7	4	3	5	4	5	6	8
	Bowels, Inflammation of	15	15	18	16	15	11	14	21	17	17	15	14	9	15
	Bronchitis	65	61	77	72	76	63	54	49	51	42	50	53	68	74
	Cerebro-spinal Meningitis	4	2	2	5	6	2	0	0	2	0	1	0	0	4
	Cholera Infantum	11	12	1	1	5	0	6	7	26	45	31	16	2	6
	Cholera Morbus	19	16	0	4	7	2	7	13	48	51	35	9	7	7
	Consumption, Pulmonary	63	58	62	59	60	63	60	50	56	50	55	62	61	55
	Croup, Membranous	4	5	10	11	2	1	1	0	3	0	7	11	11	6
	Diphtheria	15	14	17	2	9	2	8	8	10	8	15	33	32	27
	Diarrhea	46	50	34	35	29	28	39	39	74	88	94	62	41	36
	Dysentery	17	14	3	6	8	5	8	7	24	38	35	17	9	3
	Erysipelas	20	20	22	28	19	25	19	19	19	14	15	24	18	16
	Fever, Intermittent	77	55	49	50	53	63	60	66	63	58	54	55	46	47
	Fever, Remittent	54	38	34	27	32	37	43	39	37	42	39	40	41	42
	Fever, Typhoid (Enteric)	9	6	8	2	4	0	1	0	1	10	13	17	10	9
	Fever, Typho-malarial	19	11	10	14	14	7	8	4	2	5	13	17	26	13
	Influenza	37	43	50	55	70	67	50	32	15	13	31	37	45	46
	Kidney, Inflammation of	19	19	24	26	25	23	26	13	14	13	18	14	17	19
	Measles	10	2	0	3	9	1	1	1	3	0	0	1	1	2
	Neuralgia	70	76	79	76	81	77	71	74	72	73	72	72	78	80
	Pneumonia	36	28	39	51	56	40	25	17	10	8	12	10	27	39
	Puerperal Fever	3	3	2	5	1	2	1	7	1	3	1	3	4	5
	Rheumatism	71	80	69	82	82	86	85	83	74	79	79	76	82	85
	Scarlatina	16	15	4	10	25	18	12	18	16	3	13	24	15	18
	Small-pox	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tonsilitis	50	52	62	66	64	52	50	48	27	33	45	53	57	66
	Whooping-cough	19	28	13	12	17	13	26	35	43	41	35	39	35	29

*, †, d. See page 125. ‡ Inflammation of kidney was not compiled until 1884. For inflammation of brain and inflammation of bowels, an average for the seven years 1880-86; for neuralgia and tonsilitis an average for the seven years 1879-86; for other diseases and for average line an average for the ten years 1877-86.

TABLE 2.—CONTINUED.—*Diseases in the Southeastern Division of the State, for the Years 1877-1886, and by Months in 1886,—Indicating what Per Cent of the Weekly Reports Received Stated the Presence of the Diseases Named.*[d]

Div.*	Diseases.	'77-'86.‡	1886.†	Jan.†	Feb.†	March.†	April.†	May.†	June.†	July.†	Aug.†	Sept.†	Oct.†	Nov.†	Dec.†
Southeastern Division.*	Av. for Tab. Dis. Rep. Pres.	35	28	29	29	30	29	30	24	27	28	32	31	28	29
	Brain, Inflammation of	15	10	9	10	12	11	7	8	10	10	13	9	10	9
	Bowels, Inflammation of	22	20	16	17	21	19	22	14	19	24	28	22	14	27
	Bronchitis	67	58	71	70	66	54	50	42	35	41	50	74	76	73
	Cerebro-spinal Meningitis	8	8	3	10	13	9	8	7	6	6	8	8	9	12
	Cholera Infantum	17	16	6	3	4	7	7	16	30	38	44	15	5	0
	Cholera Morbus	24	21	4	1	4	17	13	12	52	59	44	25	10	5
	Consumption, Pulmonary	80	65	75	76	68	61	70	65	60	58	49	58	72	74
	Croup, Membranous	13	10	6	7	8	9	8	9	10	11	13	15	10	14
	Diphtheria	31	15	18	21	12	7	15	15	14	15	20	18	9	11
	Diarrhea	53	48	28	31	30	31	33	39	73	76	72	60	52	39
	Dysentery	27	23	10	10	14	19	12	12	17	30	58	43	19	21
	Erysipelas	33	29	35	20	26	39	42	34	29	20	27	25	29	24
	Fever, Intermittent	71	49	40	44	47	44	57	49	56	58	57	60	38	30
	Fever, Remittent	45	34	25	21	28	26	23	36	38	38	43	48	48	36
	Fever, Typhoid (Enteric)	24	16	16	11	13	9	13	7	11	20	31	20	17	20
	Fever, Typho-malarial	25	10	7	9	5	4	0	4	3	10	19	20	17	14
	Influenza	44	30	32	39	57	48	27	19	10	11	23	25	29	45
	Kidney, Inflammation of	25	29	22	21	22	41	42	24	25	27	30	32	31	32
	Measles	18	13	13	11	8	19	33	19	11	7	12	9	7	14
	Neuralgia	58	57	62	60	63	65	60	43	59	48	53	58	57	65
	Pneumonia	43	27	32	39	47	46	25	14	11	13	23	23	26	32
	Puerperal Fever	10	10	12	9	9	11	18	12	6	7	9	14	9	8
	Rheumatism	73	69	72	76	72	72	63	65	71	49	60	75	88	68
	Scarlatina	29	20	35	36	39	17	30	23	8	17	8	8	12	11
	Small-pox	4	3	0	0	0	0	0	3	6	6	3	6	5	3
	Tonsilitis	48	50	66	59	50	48	42	35	38	42	44	52	57	70
	Whooping cough	29	24	32	37	29	33	33	30	14	20	21	15	12	9

*, †, d. See page 125. ‡ Inflammation of kidney was not compiled until 1884. For inflammation of brain and inflammation of bowels, an average for the seven years 1880-86; for neuralgia and tonsilitis an average for the eight years 1879-86; for other diseases and for average line an average for the ten years 1877-86.

TABLE 4.—*A Summary for the Year 1886, relative to Diseases in each of the Eleven Divisions of the State,†—indicating the prevalence as regards both Time and Area.*

Diseases.	Western Division.*				Bay and Eastern.*				Central Division.*			
	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e
Average for Tabulated Diseases Reported Present	44	67	29	3.8	36	68	25	3.5	39	67	27	3.3
Brain, Inflammation of	15	28	4	4.8	12	32	4	6.2	13	38	5	4.2
Bowels, Inflammation of	52	49	25	4.8	30	59	18	5.0	35	48	17	4 5
Bronchitis	76	72	55	3.7	64	81	52	2.9	68	80	55	3.1
Cerebro-spinal Meningitis	8	39	3	6.0	5	47	2	5.7	11	37	4	4.6
Cholera Infantum	28	63	18	4.0	25	62	16	3.8	23	52	13	3.4
Cholera Morbus	37	55	20	4.1	27	65	18	4.2	23	58	13	3.8
Consumption, Pulmonary	56	83	46	4.5	59	88	52	3 5	61	87	54	3.6
Croup, Membranous	15	39	6	6.4	12	32	4	6.0	6	33	2	3.9
Diphtheria	19	49	10	4.8	30	51	15	3.7	25	51	12	3.3
Diarrhea	67	72	48	3.3	63	66	42	3.0	64	70	45	3.0
Dysentery	31	60	18	3.8	25	60	16	4.4	28	60	17	3.1
Erysipelas	57	51	29	4.3	33	48	15	4.7	47	58	27	4.0
Fever, Intermittent	83	80	66	2.3	69	80	55	2.5	79	75	59	2.6
Fever, Remittent	61	78	47	3.2	35	70	24	3.5	54	70	39	3.2
Fever, Typhoid (Enteric)	13	55	7	5.1	13	48	7	4.1	13	53	7	3.7
Fever, Typho-malarial	36	60	22	4.9	37	63	24	4.0	26	58	15	3.8
Influenza	62	75	47	2.5	48	71	34	2.6	47	73	35	2 6
Kidney, Inflammation of	30	44	13	4.8	31	61	19	4 6	38	55	21	4.2
Measles	15	53	8	5.2	11	59	7	4.1	6	53	3	3 3
Neuralgia	94	83	79	3 1	78	79	62	2 6	87	81	70	2.6
Pneumonia	45	53	24	4 2	43	59	26	4.0	49	54	27	3.7
Puerperal Fever	16	33	5	4.6	10	41	4	4.0	19	39	7	4.5
Rheumatism	87	80	69	3.5	83	80	67	3.0	85	81	69	2.8
Scarlatina	20	50	10	4.2	14	48	7	4.5	17	53	9	3.6
Small-pox	0	0	0	0	0	0	0	0	0	0	0	0
Tonsilitis	83	71	59	3.6	56	66	37	3.9	70	66	46	3.3
Whooping-cough	31	71	22	3.6	25	67	17	3.2	24	73	18	3.1

Diseases.	Southwestern Div.*				S. Central Div.*				Southeastern Div.*			
	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e
Average for Tabulated Diseases Reported Present	40	65	26	3.2	40	71	28	3.9	39	69	28	4.6
Brain, Inflammation of	10	45	4	5.4	13	46	6	5.8	17	59	10	9.2
Bowels, Inflammation of	29	44	13	3.9	26	60	15	5.0	35	57	20	6.4
Bronchitis	73	76	55	3.4	75	82	61	3.0	79	73	58	2.5
Cerebro-spinal Meningitis	7	31	2	5.3	7	28	2	6.3	12	69	8	14.5
Cholera Infantum	30	50	14	3.2	21	58	12	4.2	26	60	16	5.2
Cholera Morbus	29	57	16	3.1	29	53	16	3.9	35	60	21	5.5
Consumption, Pulmonary	82	86	71	3.8	67	85	58	4.3	72	90	65	3.1
Croup, Membranous	12	39	5	4.6	13	43	5	6.9	16	62	10	8.0
Diphtheria	23	36	8	3.4	23	61	14	5.3	24	61	15	4.3
Diarrhea	56	63	35	2 9	68	74	50	3.3	67	71	48	3.3
Dysentery	25	53	13	3.6	28	50	14	5.0	35	64	23	6.4
Erysipelas	51	50	26	3.8	38	53	20	4.9	46	62	29	5.1
Fever, Intermittent	80	73	58	2.6	72	78	55	3.0	69	70	49	2.8
Fever, Remittent	48	68	32	2.7	57	65	38	3.8	50	69	34	3.3
Fever, Typhoid (Enteric)	13	52	7	3.8	11	56	6	5.2	24	67	16	5.9
Fever, Typho-malarial	40	56	22	3.4	18	61	11	6.5	17	55	10	2.9
Influenza	48	65	32	2.6	57	73	43	2.6	40	76	30	3.7
Kidney, Inflammation of	31	47	14	4.4	34	57	19	5.1	46	63	29	5.5
Measles	11	41	4	3.0	6	34	2	4 9	19	67	13	7.0
Neuralgia	89	81	71	2.5	88	86	76	2.7	78	74	57	2.9
Pneumonia	53	53	28	3.5	48	57	28	4.3	46	60	27	4.4
Puerperal Fever	10	37	4	3.3	9	34	3	6.2	17	58	10	10.9
Rheumatism	89	84	75	2 7	90	89	80	3.1	87	79	69	3.3
Scarlatina	20	41	8	3.2	24	61	15	5.0	32	64	20	4.5
Small-pox	0	0	0	0	0	0	0	0	4	71	3	25.9
Tonsilitis	75	68	51	3.3	69	76	52	3.5	76	66	50	2.9
Whooping-cough	18	57	10	2 7	40	71	28	3.9	33	71	24	5.0

* For counties in each division see Exhibit I, page 111. b, c, d, e, See foot-notes with these marks in Table 2, page 125.
† This page includes the Six Divisions of the State from which the most Weekly Reports were received.

TABLE 4.—CONTINUED.†

Diseases.	Upper Peninsular Div.*				Northwestern Div.*				Northern Division.*				Northeastern Div.*				Northern Central Div.*			
	Per Cent of Observers Reporting presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e	Per Cent of Observers Reporting Presence of. b	Av. Per Cent of Weeks Reported Present where Present. c	Per Cent of Reports Stating Presence of. d	Av. Order of Prevalence where Present. e
Average for Tabulated Diseases Reported Present	41	67	27	4.0	40	74	31	5.9	19	53	10	2.1	41	64	26	3.3	35	65	22	3.5
Brain, Inflammation of	31	43	13	5.5	5	20	1	1.0	5	67	4	1.5	18	31	6	3.0	2	40	1	5.0
Bowels, Inflammation of	36	42	15	5.8	11	43	4	6.5	5	50	2	3.0	42	44	20	4.3	16	40	7	3.0
Bronchitis	85	82	70	1.9	68	81	56	5.0	18	86	15	1.7	95	89	85	2.1	53	75	40	3.0
Cerebro spinal Meningitis	18	38	7	7.7	0	0	0	0.0	5	33	2	2.0	11	33	5	2.8	8	25	2	6.0
Cholera Infantum	28	40	12	2.5	37	63	23	6,3	10	53	6	1.8	18	59	10	3.3	37	52	19	3.9
Cholera Morbus	31	54	17	4.5	37	54	20	5.1	5	25	1	1.5	18	56	10	3.7	33	58	18	3.4
Consumption Pulmonary	79	89	69	3.1	68	93	67	8.5	28	67	19	2.6	55	86	47	4.4	41	66	28	5.2
Croup, Membranous	23	45	11	4.9	16	29	5	7.7	5	25	1	2.0	24	29	7	6.2	12	26	4	4.7
Diphtheria	18	79	15	6.6	16	38	7	11.0	8	43	4	2.0	42	55	23	4.2	20	52	11	4.1
Diarrhea	69	79	54	3.3	79	74	60	5.8	36	39	14	2.1	79	69	54	2.7	61	76	47	3.2
Dysentery	49	54	26	4.3	58	58	31	5.8	15	46	7	2.2	45	59	26	4.6	39	56	21	3.4
Erysipelas	33	43	15	5.2	37	39	17	7.6	23	33	7	2.0	53	38	20	3.5	41	54	22	5.3
Fever, Intermittent	28	50	14	2,7	63	100	65	2.8	46	65	31	1.9	47	55	27	3.2	76	82	62	2.5
Fever, Remittent	23	47	11	5.9	68	96	67	2.8	8	33	2	3.7	26	27	8	3.3	51	73	39	2.4
Fever, Typhoid (Enteric)	28	53	15	5.6	21	27	5	8.8	26	60	16	2.3	5	63	3	2.5	16	32	6	3.6
Fever, Typho-malarial	21	45	10	2.0	26	60	16	5.8	15	35	6	2.0	16	38	6	4.7	41	53	22	4.3
Influenza	46	81	37	2.7	53	86	48	4.3	10	41	4	1.0	47	75	36	1.4	12	48	6	2.7
Kidney, Inflammation of	62	80	50	5.0	16	46	8	4.0	3	25	1	2,0	37	39	15	3.5	22	60	13	4.0
Measles	21	52	10	3.0	16	47	9	9,0	0	0	0	0	5	33	2	4.5	2	25	1	6.0
Neuralgia	77	76	58	2.7	68	94	68	5.6	28	57	16	2.2	97	92	90	2.8	73	72	54	3.2
Pneumonia	46	68	33	4.8	68	68	48	5.2	46	51	25	2.1	66	52	35	4.5	37	51	20	4.4
Puerperal Fever	8	31	3	7.3	16	29	5	7.0	8	25	2	2.0	3	20	1	3.0	4	44	2	5.5
Rheumatism	87	66	56	4.6	74	91	71	6.1	46	64	29	2.1	92	83	78	3.3	71	86	62	3.1
Scarlatina	15	52	8	8.0	21	53	12	10.0	10	22	2	2.5	8	38	3	4.0	2	20	1	9.0
Small-pox	0	0	0	0.0	0	0	0	0.0	0	0	0	[illegible]	0	0	0	0	0	0	0	0
Tonsilitis	59	76	43	3.3	63	44	59	7.8	51	60	32	2.1	89	68	62	2.8	69	77	53	3.5
Whooping-cough	36	91	34	4.6	5	2	3	8.0	13	65	8	1,6	21	32	6	2.5	20	54	11	2.1

* For counties in each division see Exhibit I, page 111. b, c, d, e. See foot notes with these marks in Table 2, page 125.
† This page includes the Five Divisions of the State from which the fewest Weekly Reports were received.

WHAT DISEASES CAUSE MOST SICKNESS?

This is shown in Exhibit VI., in this report, and in similar exhibits in previous reports. The question is differently answered in different years. For many years after the compilation of weekly reports was begun, intermittent fever appeared to be the leading cause of sickness in Michigan. In 1884 neuralgia headed the list, with rheumatism second and intermittent fever third. In 1885 neuralgia again headed the list, with intermittent fever second, and rheumatism third. In 1886 rheumatism heads the list, with neuralgia second, bronchitis third, and intermittent fever fourth. Nearly the same diseases appear above the average line each year. Pneumonia has appeared in this exhibit tenth in order for seven years in succession. Some of the diseases of minor importance vary considerably in their order. Whooping-cough, for example, in 1881 and 1883 was nineteenth in order, and rose to twelfth in order in 1886.

Exhibit VII. supplies data relative to what diseases caused most sickness in 1886 in each of several geographical divisions of Michigan. It may be seen that there is evidence that there are very great differences in the different parts of the State. Further evidence is very desirable, however, in order to reach conclusions on this important subject. The exhibit will be found of great interest to those who study it carefully, and in connection with previous reports.

EXHIBIT VI.—*Diseases from which there seems to have been the Most Sickness in Michigan in 1886, as indicated by the Per Cent of Weekly Reports Stating Presence of the Diseases, studied in connection with the Average Order of Prevalence of said Diseases when Reported Present, also Order, Per Cent of Reports, and Average Order for the same Diseases in 1885, 1884, 1883, and 1882.*

	1886.				1885.			1884.			1883.			1882.		
	Order.*	Diseases, in Order of Apparent Amount of Sickness in 1886, Most Prevalent Disease First.	Per Cent of Reports Stating Presence of, *d*	Av. Order of Prevalence when Present, *e*	Order.*	Per Cent of Reports Stating Presence of, *d*	Av. Order of Prevalence when Present, *e*	Order.*	Per Cent of Reports Stating Presence of, *d*	Av. Order of Prevalence when Present, *e*	Order.*	Per Cent of Reports Stating Presence of, *d*	Av. Order of Prevalence when Present, *e*	Order.*	Per Cent of Reports Stating Presence of, *d*	Av. Order of Prevalence when Present, *e*
More Sickness than Average for 27 Diseases, in 1886.	1	Rheumatism	70	3.2	3	68	3.2	2	70	3.6	4	68	3.7	4	68	3.8
	2	Neuralgia	67	2.8	1	68	2.8	1	70	3.3	2	69	3.3	2	68	3.6
	3	Bronchitis	56	3.0	4	56	3.1	4	61	3.2	3	66	3.2	3	65	3.3
	4	Intermittent Fever	54	2.6	2	59	2.4	3	65	2.5	1	69	2.3	1	71	2.0
	5	Consumption, Pulmona'y	55	3.9	5	58	4.0	5	63	4.3	5	61	4.5	5	66	4.6
	6	Tonsilitis	49	3.4	6	50	3.5	7	50	3.7	7	50	3.9	9	47	3.9
	7	Diarrhea	45	3.2	7	46	3.3	6	52	3.3	6	49	3.7	7	48	3.8
	8	Influenza	35	2.7	8	34	2.9	9	41	3.3	8	43	3.2	8	40	3.1
	9	Remittent Fever	34	3.3	9	36	3.2	8	44	3.3	9	41	3.3	6	48	3.3
	(10)	Average	26	3.7	(10)	26	3.8	(10)	29	4.2	(11)	30	4.2	(11)	30	4.2
Less than said Average.	10	Pneumonia	27	4.0	10	27	4.4	10	29	4.5	10	38	4.7	10	39	4.4
	11	Erysipelas	23	4.5	11	24	4.6	12	26	5.2	12	25	5.5	15	22	5.5
	12	Whooping-cough	20	3.7	13	14	4.1	13	23	4.5	19	15	5.2	13	17	4.4
	13	Inflammation of Kidney	20	4.7	12	21	4.4	11	26	5.0	----	----	----	----	----	----
	14	Cholera Morbus	17	4.2	15	17	4.5	15	22	4.9	15	18	5.0	16	17	5.2
	15	Dysentery	17	4.5	19	15	5.0	14	23	5.0	13	21	5.2	17	17	5.3

* Judging from the per cent of reports which stated presence of the diseases, in connection with the order of prevalence when present.

† For 1883 and 1882 the average is for 26 diseases.

d This column states what per cent the number of reports stating presence of a disease is of the whole number of reports received for the time specified, from *all observers* in the State. It combines and states in a general way, an idea of the *time* a disease was prevalent, with an idea of the area of its prevalence.

e The disease having the greatest number of cases was to be marked 1 in the order; the disease having the next greatest number of cases, 2; and so on. Diseases not present were to be marked 0. The numbers in this column are found by dividing the totals of the Order of Prevalence columns, in Table 3 (omitted in this Report), by the number of men who reported the disease present. The column is, therefore, an average not for all the localities represented, but only for those at which the given disease was reported present. The numbers in the "Average" lines for this column are found by dividing the sum of the totals in the order of prevalence columns, in Table 3, for all diseases reported present, by the sum of the numbers of men who reported the different diseases present, thus counting each man once for every disease he reported present. As a rule, small numbers in this column indicate the large prevalence of the disease, and *vice versa*; but the greater the number of diseases reported present by each observer, from week to week, the greater will be the "average" in this column.

EXHIBIT VII.—*In each of eleven Geographical Divisions* of the State, the fifteen Diseases from which there seems to have been the Greatest Amount of Sickness in 1886, as indicated by the Per Cent of Weekly Reports Stating Presence of each of 27 Leading Diseases, when studied in connection with the Average Order of Prevalence of said diseases when reported present.*

	Order.†	Diseases in Order of Apparent Amount of Sickness, Most Prevalent Disease First.	Per Cent of Reports Stating Pres'nce of.[d]	Av. Order of Prevalence when Pres.[e]	Diseases in Order of Apparent Amount of Sickness, Most Prevalent Disease First.	Per Cent of Reports Stating Pres'nce of.[d]	Av. Order of Prevalence when Pres.[e]	Diseases in Order of Apparent Amount of Sickness, Most Prevalent Disease First.	Per Cent of Reports Stating Pres'nce of.[d]	Av. Order of Prevalence when Pres.[e]
		UPPER PENINSULAR DIV.*			NORTHWESTERN DIV.*			NORTHERN DIVISION.*		
More Sickness than Average for 27 Diseases.	1	Bronchitis	70	1.9	Remittent Fever	67	2.8	Intermittent Fever	31	1.9
	2	Consumption, Pul.	69	3.1	Intermittent Fever	65	2.8	Tonsilitis	32	2.1
	3	Neuralgia	58	2.7	Neuralgia	68	5.6	Rheumatism	29	2.1
	4	Diarrhea	54	3.3	Rheumatism	76	6.1	Pneumonia	25	2.1
	5	Influenza	37	2.7	Bronchitis	50	5.6	Bronchitis	15	1.7
	6	Tonsilitis	43	3.3	Diarrhea	60	5.8	Influenza	4	1.0
	7	Rheumatism	56	4.6	Influenza	48	4.3	Neuralgia	16	2.2
	8	Inflam. of Kidney	50	5.0	Pneumonia	48	5.2	Diarrhea	14	2.1
	9	Typho-mal. Fever	10	2.0	Consumption, Pul.	67	8.5	Whooping-cough	8	1.6
	10	Cholera Infantum	12	2.5	Tonsilitis	59	7.8	Typhoid Fever	16	2.3
	11	Intermittent Fever	14	2.7	Inflam. of Brain	1	1.0	Consumption, Pul.	19	2.6
	12	Whooping-cough	34	4.6	Dysentery	31	5.8	Inflam. of Brain	4	1.5
	(13)	Av. for 27 Diseases	27	4.0	Av. for 27 Diseases	31	5.9	Av. for 27 Diseases	10	2.1
Less	13	Pneumonia	33	4.8	Cholera Morbus	20	5.1	Cholera Infantum	6	1.8
	14	Dysentery	26	4.3	Inflam. of Kidney	8	4.0	Erysipelas	7	2.0
	15	Measles	10	3.0	Cholera Infantum	23	6.3	Cholera Morbus	1	1.5
		NORTHEASTERN DIV.*			NORTHERN CENTRAL DIVISION.*					
More Sickness than Av. for 27 Diseases.	1	Bronchitis	85	2.1	Intermittent Fever				62	2.5
	2	Neuralgia	90	2.8	Rheumatism				62	3.1
	3	Rheumatism	78	3.3	Neuralgia				54	3.2
	4	Tonsilitis	62	2.8	Tonsilitis				53	3.5
	5	Influenza	36	1.4	Diarrhea				47	3.2
	6	Diarrhea	54	2.7	Remittent Fever				39	2.4
	7	Intermittent Fever	27	3.2	Bronchitis				40	3.0
	8	Consumption, Pul.	47	4.4	Whooping-cough				11	2.1
	(9)	Av. for 27 Diseases	26	3.3	Average for 27 Diseases				22	3.5
	9	Whooping-cough	6	2.5	Dysentery				21	3.4
	10	Erysipelas	20	3.3	Cholera Morbus				18	3.4
	11	Typhoid Fever	3	2.5	Typho-malarial Fever				22	4.3
Less	12	Pneumonia	35	4.5	Cholera Infantum				19	3.9
	13	Cerebro-spinal Men	3	2.8	Influenza				6	2.7
	14	Inflam. of Brain	6	3.0	Consumption, Pulmonary				28	5.2
	15	Inflam. of Kidney	15	3.5	Pneumonia				20	4.4

* For counties in each division see Exhibit I, page 111.

† Judging from the per cent of reports in connection with the "average order of prevalence where present." d, e, See footnotes with these marks on page 125.

EXHIBIT VII.—CONTINUED.

	Order.*	Diseases in Order of Apparent Amount of Sickness. Most Prevalent Disease First.	Per Cent of Reports Stating Pres'nce of.d	Av. Order of Prevalence when Pres.e	Diseases in Order of Apparent Amount of Sickness. Most Prevalent Disease First.	Per Cent. of Reports Stating Pres'nce of.d	Av. Order of Prevalence when Pres.e	Diseases in Order of Apparent Amount of Sickness. Most Prevalent Disease First.	Per Cent. of Reports Stating Pres'nce of.d	Av. Order of Prevalence when Pres.e
		WESTERN DIVISION.*			BAY AND EAST'N DIV.*			CENTRAL DIV.*		
More Sickness than Av. for 27 Diseases.	1	Intermittent Fever.	66	2.3	Neuralgia	62	2.6	Neuralgia	70	2.6
	2	Neuralgia	79	3.1	Rheumatism	67	3.0	Rheumatism	69	2.8
	3	Rheumatism	69	3.5	Intermittent Fever.	55	2.5	Intermittent Fever.	59	2.6
	4	Influenza	47	2.5	Bronchitis	52	2.9	Bronchitis	55	3.1
	5	Tonsilitis	59	3.6	Consumption, Pul.	52	3.5	Influenza	35	2.6
	6	Diarrhea	48	3.3	Diarrhea	42	3.0	Diarrhea	45	3.0
	7	Remittent Fever.	47	3.2	Influenza	34	2.6	Consumption, Pul.	54	3.6
	8	Bronchitis	55	3.7	Tonsilitis	37	3.9	Tonsilitis	46	3.3
	9	Consumption, Pul.	46	4.5				Remittent Fever	39	3.2
	(9)				Av. for 27 Diseases.	25	3.5			
	(10)	Av. for 27 Diseases.	29	3.8				Av. for 27 Diseases.	27	3.3
Less	9				Remittent Fever	24	3.5			
	10	Whooping-cough	22	3.6	Whooping-cough	17	3.2	Whooping-cough	18	3.1
	11	Erysipelas	29	4.3	Pneumonia	26	4.0	Dysentery	17	3.1
	12	Dysentery	18	3.8	Typho-mal. Fever.	24	4.0	Pneumonia	27	3.7
	13	Pneumonia	24	4.2	Diphtheria	15	3.7	Diphtheria	12	3.3
	14	Cholera Morbus	20	4.1	Cholera Infantum	16	3.8	Cholera Infantum.	13	3.4
	15	Cholera Infantum.	18	4.0	Cholera Morbus	18	4.2	Erysipelas	27	4.0
		SOUTHWESTERN DIV.*			SOUTHERN-CEN. DIV.*			SOUTHEASTERN DIVISION.*		
More Sickness than Av. for 27 Diseases.	1	Neuralgia	71	2.5	Neuralgia	76	2.7	Rheumatism	69	3.3
	2	Rheumatism	75	2.7	Rheumatism	80	3.1	Consumption, Pul.	65	3.1
	3	Intermittent Fever.	58	2.6	Bronchitis	61	3.0	Bronchitis	58	2.5
	4	Consumption, Pul.	71	3.8	Intermittent Fever	55	3.0	Neuralgia	57	2.9
	5	Bronchitis	55	3.4	Influenza	43	2.6	Tonsilitis	50	2.9
	6	Tonsilitis	51	3.3	Diarrhea	50	3.3	Intermittent Fever.	49	2.8
	7	Influenza	32	2.6	Tonsilitis	52	3.5	Diarrhea	48	3.3
	8	Remittent Fever.	32	2.7	Consumption, Pul.	58	4.3	Remittent Fever.	34	3.3
	9	Diarrhea	35	2.9	Remittent Fever.	38	3.8	Influenza	30	3.7
	10				Whooping-cough	28	3.9			
	(10)	Av. for 27 Diseases.	26	3.2				Av. for 27 Diseases.	28	4.6
	(11)				Av. for 27 Diseases.	28	3.9			
Less	10	Whooping-cough	10	2.7				Erysipelas	29	5.1
	11	Pneumonia	28	3.5	Pneumonia	28	4.3	Pneumonia	27	4.4
	12	Cholera Morbus	16	3.1	Cholera Morbus	16	3.9	Inflam. of Kidney	29	5.5
	13	Typho-mal. Fever.	22	3.4	Cholera Infantum	12	4.2	Whooping-cough	24	5.0
	14	Cholera Infantum.	14	3.2	Erysipelas	20	4.9	Scarlatina	20	4.5
	15	Erysipelas	26	3.8	Inflam. of Kidney	19	5.1	Dysentery	23	6.0

* For counties in each division see Exhibit I., page 111.
† Judging from the per cent of reports in connection with the "average order of prevalence where present." d, e. See foot-notes with these marks on page 125.

EXHIBIT VIII.—*Names of Stations where were made the Observations of Meteorological Conditions used in Exhibit X., and following exhibits, relative to Sickness and Meteorological Conditions in 1886; also the Temperature, Humidity, Cloudiness, Ozone, Velocity of Wind, or Atmospheric Pressure, at each Station for which Observations of the given condition are included in the summary statements relative to that condition in said exhibits.*

Stations.* (Those of U. S. Signal Service in Italics.)	Temperature.		Humidity.		Per Cent of Cloudiness.	Ozone.		Wind, Av. Velocity.	Atmospheric Pressure.		
	Av. Daily Range.	Average.	Relative.	Absolute.		Day.	Night.		Range. Monthly.	Range. Av. Daily.	Average.
Number of Stations included in average	18	17	16	16	18	10	10	9	14	14	14
Average	18.29	46.11	75	3.44	56	3.06	3.23	9.5	1.927	.205	29.158
Marquette	17.73	39.73	77	2.78	60	3.44	3.26	9.3	.972	.211	29.257
Escanaba	16.59	39.69	77	2.90	55	.....	.....	8.0	1.004	.209	29.331
Traverse City	18.21	43.79	84	3.46	58	2.72	2.76	.....	1.008	.209	29.307
Mackinaw City	15.87	41.55	73	2.93	52	.....	.....	9.8	.999	.211	29.322
Alpena	15.98	40.53	82	3.05	59	3.20	4.87	8.8	1.036	.213	29.333
Harrisville	21.61	43.28	65	2.86	60	4.52	5.90	.....	1.027	.226	29.312
Grand Haven	14.89	44.91	77	3.30	58	.....	.....	10.5	.943	.199	29.328
Muskegon	.....	46.51	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pentwater	25.02	44.80	77	3.30	56	2.52	3.16	.....	.....	.....	.....
East Saginaw	21.47	.....	.....	.....	54	.....	.....	.....	.....	.....	.....
Port Huron	16.12	44.33	78	3.32	53	.....	.....	9.5	.974	.201	29.322
Thornville	16.70	48.02	79	3.69	49	2.41	3.08	.....	.945	.201	28.937
Agricultural College	20.60	46.20	78	3.50	57	.....	.....	.....	.929	.198	29.089
Lansing	19.76	46.19	75	3.37	58	3.11	3.74	9.5	.931	.193	29.075
Otsego	.....	.....	.....	.....	39	.....	.....	.....	.....	.....	.....
Ann Arbor	17.77	46.76	76	3.46	56	2.92	2.87	8.5	.963	.199	29.024
Hudson	22.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kalamazoo	17.05	47.46	74	3.47	61	2.23	2.38	.....	.....	.....	.....
Marshall	20.27	49.29	80	3.90	50	2.80	2.62	.....	.906	.198	29 026
Detroit	15.42	48.95	76	3.75	54	.....	.....	8.9	.953	.197	29.314

* At the U. S. Signal Service Stations the observations of mean temperature, humidity, cloudiness, and atmospheric pressure were made at 7 A. M., 3 P. M., and 11 P. M., seventy-fifth meridian time, which is faster than local time, as follows: At Port Huron, 30 m.; at Detroit, 32 m.; at Alpena, 34 m.; at Grand Haven, 45 m.; at Escanaba, 48 m.; at Marquette, 49 m. At the other stations the observations of these conditions were made at 7 A. M., 2 P. M., and 9 P. M., local time. Observations of range of temperature were made with registering thermometers read and set at 11 P. M., at the Signal Service Stations; at 7 A. M. at other stations. For the ozone observations the test-paper was exposed from 7 A. M. to 2 P. M. for the day observations, and from 9 P. M. to 7 A. M. for the night observations. The velocity of wind was recorded by registering anemometers. These subjects are treated by months in 1886 and for previous years, in an article on Meteorological Conditions in Michigan in 1886 on pages 29-104 of this Report.

EXHIBIT IX.—*Showing Comparisons between the Averages of certain Meteorological Conditions at Stations in Michigan in 1886, with those in preceding Years. (Abstracted from Exhibit 5, page 33; Exhibit 8, page 52; Exhibit 11, page 56; Exhibit 13, page 57; Exhibit 18, page 68; Exhibit 22, page 79; Exhibits 24 and 25, page 80; Exhibit 29, page 99; Exhibit 28, page 88.)*

Meteorological Conditions.		Av.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average Temperature	In 1886 higher than Av. for 10 years, 1877-86	.....	.....	.....	0.30	1.71	.....	.....	.....	.....	.....	1.01	.....	.....
	Lower	1.29	1.84	2.44	.....	.....	1.39	1.79	1.84	0.78	0.52	.....	1.72	6.16
Av. Daily Range of Temp	In 1886 more than Av. for 8 years, 1879-86	0.24	.....	.....	.....	0.70	1.04	1.40	2.44	.....	.....	1.62	0.42	1.88
	Less	.....	2.69	0.83	2.09	.....	.....	.....	.....	0.07	0.91	.....	.....	.....
Absolute Humidity	In 1886 more than Av. for 10 years, 1877-86	.....	.....	.....	1.01	0.36	.....	.....	.....	.....	.....	.....	.....	.....
	Less	0.12	0.06	0.03	.....	.....	0.09	0.29	0.48	0.09	0.04	0.07	0.28	0.37
Relative Humidity	In 1886 more than Av. for 9 years, 1878-86	2	4	2	3	7	4	0	.....	1	3	.....	.....	0
	Less	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	3	.....
Rainfall	In 1886 more than Av. for 10 years, 1877-86	.....	0.92	.....	0.21	.....	.....	.....	.....	0.63	1.79	.....	.....	.....
	Less	5.02	.....	0.82	.....	0.25	0.83	1.93	2.25	.....	.....	1.65	0.88	0.63
Velocity of Wind	In 1886 more than Av. for 5 years, 1882-86	.....	.....	0.8	.....	.....	.....	.....	.....	.....	0.5	.....	1.3	.....
	Less	0.3	0.7	.....	0.1	1.3	1.1	0.8	0.9	0.2	.....	0.3	.....	0.4
Cloudiness	In 1886 more than Av. for 10 years, 1877-86	.....	11	6	.....	1	0	.....	.....	0	6	.....	.....	.....
	Less	1	.....	.....	1	.....	0	5	6	0	.....	11	5	9
Day Ozone	In 1886 more than Av. for 10 years, 1877-86	.....	.....	.....	.....	.....	.....	0.01	.....	0.16	0.20	0.36	0.29	0.36
	Less	0.07	0.46	0.54	0.55	0.32	0.18	.....	0.18	.....	.....	.....	.....	.....
Night Ozone	In 1886 more than Av. for 10 years, 1877-86	0.23	.....	.....	.....	.....	.....	0.30	0.33	0.79	0.91	0.54	0.24	0.05
	Less	.....	0.02	0.14	0.44	0.30	0.01	.....	.....	.....	.....	.....	.....	.....
Atmospheric Pressure	In 1886 greater than Av. for 10 years 1877-86	.034	.....	.008	.....	.106	.001	.055	.046	.023	.035	.129	.....	.081
	Less	.....	.015	.....	.017	.....	.....	.....	.....	.....	.....	.....	.036	.....

CLIMATE AND SICKNESS.*

Exhibit X., page 144, (and similar exhibits in previous reports) is an attempt to learn something of the relations of bronchitis to meteorological conditions, by noting whether each meteorological condition was above or below its average for the year, in months when more or in months when less bronchitis than the average for the year was reported. The months are arranged in order according to the prevalence of bronchitis: those months in which most bronchitis was reported being placed first in the column; those in which more bronchitis than the average was reported are placed above the average line, the others below that line. The meteorological conditions for each month are printed, in the proper columns, in the line for the month. The statements being thus arranged, it is easy to see whether the temperature, the velocity of the wind, or any other condition represented, was above its annual average in months when more than the average amount of bronchitis was reported, or *vice versa*.

That the comparisons may the more readily be held in mind, propositions have been made concerning the relations of bronchitis to meteorological conditions, grouping the conditions into two classes. The letters *a* and *b* in the Exhibit mark exceptions to these propositions. It is not supposed that the propositions are in every case true concerning every disease; but the propositions serve to bring out the evidence of the exhibit on the subject in question. This evidence is appreciated by noting the number and force of the exceptions to the propositions, and also whether the exception is explained by facts shown in other columns. A summary of the evidence is presented in Exhibit XXIV., near the close of this article.

Exhibits and propositions similar to those relative to bronchitis, but relating to other diseases, are given on following pages. The propositions are differently stated for the summer diseases (beginning with the exhibit on diarrhea) and for the winter diseases (beginning with that on bronchitis), but they are not changed to fit the individual diseases under each class.

RELATIONS OF BRONCHITIS TO METEOROLOGICAL CONDITIONS.

PROPOSITION 1.—That in months when **more** than the average per cent of weekly reports stated the presence of Bronchitis the average daily range of temperature, the relative humidity of the atmosphere, the average per cent of cloudiness, the ozone, the average velocity of the wind, the monthly and the average daily range of the barometer, and the average daily pressure of the atmosphere were **greater** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of Bronchitis these conditions were **less** than the average for the year. In Exhibit X, page 144, the letter *a* marks exceptions to this proposition for the year 1886.

PROPOSITION 2.—That in months when **more** than the average per cent of weekly reports stated the presence of Bronchitis, the average daily temperature, and the absolute humidity of the atmosphere were **less** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of Bronchitis these conditions were **greater** than

* The remarks under this head are applicable, also, by changing the name of the disease to diseases treated in Exhibits XII, XIV, XV, XVI and XVII, on following pages. The meteorological data are from places indicated in Exhibit VIII, page 140.

the average for the year. In Exhibit X, page 144, the letter *b* marks exceptions to this proposition for months in 1886.

PROPOSITION 3.—For those months which are not, as regards the absolute humidity of the atmosphere, exceptions to Proposition 2, it is true also that the quantity of vapor inhaled daily was **less** than the average, and the quantity exhaled daily in excess of that inhaled was **greater** than the average in months when **more** than the average per cent of reports stated presence of Bronchitis; and that **more** vapor was inhaled and a **less** excess exhaled daily in months when the per cent of reports stating presence of Bronchitis was **less** than the average.

EXHIBIT XI.—SICKNESS FROM BRONCHITIS, 1877–86.—*By Year and Months for each of the Ten Years 1877–86. Stating on what per cent of the Weekly Reports received Bronchitis was reported present, and comparing the Per Cents for 1886 with the Averages for corresponding Months in those Years.*

Years, etc.	Annual Av.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average 10 Years, 1877-86	61	77	78	77	71	61	53	43	41	48	54	66	71
1877	55	76	72	72	65	45	31	25	22	37	48	71	77
1878	64	77	75	74	71	65	56	41	45	55	60	73	81
1879	64	83	87	83	78	65	54	40	41	50	59	65	77
1880	64	81	84	82	68	59	57	44	45	46	57	67	72
1881	62	86	86	80	78	62	53	38	37	44	44	66	68
1882	65	73	70	75	74	70	62	51	44	57	59	71	71
1883	66	77	80	82	76	70	62	56	53	53	57	61	69
1884	61	71	71	71	65	59	56	49	47	50	56	69	70
1885	56	73	74	76	73	56	52	44	39	45	51	58	64
1886	56	71	69	71	65	57	45	40	37	41	51	61	65
In 1886 **Greater** than Av. 1877-86													
In 1886 **Less** than Av. 1877-86	5	6	9	6	6	4	8	3	4	7	3	5	6

EXHIBIT X.—BRONCHITIS.—*Stating for the Year, and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Diseases Stated Presence of Bronchitis, and what were the Meteorological Conditions observed at Stations in Michigan.**

Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Bronchitis. Per Cent of Weekly Reports Stating Presence of.†	Bronchitis. Av. Order of Prevalence where Present.†‡	Temperature, F. Average Daily Range, by Registering Thermometers.	Temperature, F. Average of 3 Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute—Grains of Vapor in a Cubic Foot of Air.	Vapor Inhaled and Exhaled from the Air Passages by one Person in 24 Hours. Troy Ounces. Inhaled.‖	Vapor Inhaled and Exhaled from the Air Passages by one Person in 24 Hours. Troy Ounces. Exhaled in Excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°. Day Observation, 7 A. M. to 2 P. M.	Ozone—Relative Scale of 10°. Night Observations, 9 P. M. to 7 A. M.	Average Velocity of Wind, Miles per Hour, by Anemometer.	Atmospheric Pressure. Inches Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure. Inches Reduced to 32° F. Range. Average Daily, by 3 Daily Observations.**	Atmospheric Pressure. Inches Reduced to 32° F. Average Pressure.
More than Av. Per Cent of Bronchitis. March	71	2.6	a15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.63	10.1	1.339	.248	a29.126
Jan.	71	2.5	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
Feb.	69	2.6	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
April	65	2.8	20.11	b46.04	a76	3.11	1.94	9.74	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
Dec.	65	2.7	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
Nov.	61	2.8	a15.11	34.32	a76	2.02	1.26	10.42	63	3.30	3.59	12.0	1.213	.269	a29.137
May	57	2.9	21.87	b54.69	a72	b3.82	2.39	9.29	a48	a2.91	a3.27	a8.4	a.728	a.157	a29.128
Average	56	3.0	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Bronchitis. Oct.	51	3.2	a19.31	51.84	75	3.64	2.28	9.40	45	a3.14	a3.53	8.8	a1.406	a.229	a29.331
June	45	3.0	a22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
Sept.	41	4.0	a18.83	61.15	a78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	a29.222
July	40	3.7	a22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
Aug.	37	3.9	a19.77	67.36	75	5.75	3.59	8.09	43	a3.04	3.28	7.4	.597	.142	29.166

a An exception to the proposition that **more** than the average per cent of weekly reports stated presence of bronchitis in months when the meteorological condition named at the head of the column was **greater** than the average for the year; and **less** in months when the same condition was **less** than the average. See proposition 1, relating to bronchitis, page 142.

b An exception to the proposition that **more** than the average per cent of weekly reports stated presence of bronchitis in months when the meteorological condition named at the head of the column was **less** than the average for the year; and **less** in months when the same condition was **greater** than the average for the year. See proposition 2, relating to bronchitis, page 142.

* How many stations, and what stations, are represented in the statements for each meteorological subject may be seen by referring to Exhibit VIII., page 140, in which the stations are named, and a statement for the year 1886, in relation to each meteorological subject, is given for each station included in the average for that subject. In Exhibit VIII. is also stated what time the tri-daily observations were made at each station. Additional statements relative to meteorological conditions may be found in an article on the Principal Meteorological conditions in Michigan in 1885, on pages 29-104 of this Report.

† Explanations of statements in these columns, and other statements relative to the prevalence, in 1886, of the diseases under consideration, may be found in Tables 2, pp. 124-127, and 4, page 134, of this Report, and also in Diagrams 1 (p. 113), 2, 3, 4, and 5, on following pages. When the per cent of reports stated for any disease is the same for two months or for any month is the same as the average, the order of months in the first column of these exhibits has been determined by reference to fractional per cents.

‡ Small numbers in this column indicate great prevalence in the localities where the disease occurred, as compared with other diseases; and large numbers a less prevalence.

§ Calculated from readings of dry bulb and wet bulb thermometers.

‖ Calculated for 18 respirations per minute, of 20 cubic inches of air each.

¶ Assuming the air exhaled to be saturated with vapor at the temperature of 98° F., in which case each cubic foot of air contains 18.69 grains of vapor, and 18 respirations per minute, of 20 cubic inches of air each, make 11.68 Troy ounces of vapor exhaled daily. No correction has been made for expansion of air after it is inhaled.

** The daily range from which numbers in this column were computed is the difference between the highest and the lowest of the four observations taken during the 24 hours, namely, at 7 A. M., 2 P. M., 9 P. M., of one day, and 7 A. M. of the following day, or at U. S. Signal Service Stations at 7 A. M., 3 P. M., 11 P. M., and 7 A. M., seventy-fifth meridian time, as stated in the * foot-note on page 140.

Proposition 3 also holds true in relation to pneumonia, membranous croup, diphtheria, tonsilitis, influenza, scarlet fever, rheumatism, neuralgia, and pulmonary consumption, treated in Exhibits XII, XIV, XV, XVI, and XVII, on following pages.

What per cent of weekly reports received in 1886 stated presence of bronchitis is graphically represented by months in Diagram 1, page 113.

The evidence of Exhibit X confirms that of similar exhibits relating to bronchitis in previous years.

What per cent of the reports received stated presence of bronchitis by months in each of the years 1877–86; also the average for those years, and a comparison of 1886 with that average, are shown in Exhibit XI above.

RELATIONS OF PNEUMONIA AND OTHER "COLD WEATHER" DISEASES TO METEOROLOGICAL CONDITIONS.

PROPOSITION 1.—That in months when **more** than the average per cent of weekly reports stated the presence of pneumonia (or of membranous croup, diphtheria, tonsilitis, influenza, scarlet fever, rheumatism, neuralgia, or pulmonary consumption), the average daily range of temperature, the relative humidity of the atmosphere, the average per cent of cloudiness, the ozone, the average velocity of the wind, the monthly and the average daily range of the barometer, and the average daily pressure of the atmosphere, were **greater** than the average for the year; and in months when **less** than the average per cent of the reports stated the presence of pneumonia (or of the other diseases named), these conditions were **less** than the average for the year. In Exhibits XII–XVII, on page 147 and the following pages, the letter *a* marks exceptions to this proposition for the year 1886.

PROPOSITION 2.—That in months when **more** than the average per cent of weekly reports stated the presence of pneumonia (or of membranous croup, diphtheria, tonsilitis, influenza, scarlet fever, rheumatism, neuralgia, or pulmorary consumption), the average daily temperature and the absolute humidity of the atmosphere were **less** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of pneumonia (or of the other diseases named), these conditions were **greater** than the average for the year. In Exhibits XII–XVII., on page 147 and following pages, the letter *b* marks exceptions to this proposition for the year 1886.

What per cent of the weekly reports received in 1886 stated presence of pneumonia is graphically represented by months in Diagram 1, page 113. What per cent of weekly reports received stated presence of pneumonia, and of the other diseases mentioned in the two preceding propositions by months in the years 1877–86, is stated in Exhibit XIII, page 148, where are also given an average for those years and a comparison of 1886 with that average.

From Exhibit XIII it may be seen that pneumonia was considerably less in 1886 than the average for the ten years, 1877–86, and also less in each month in 1886 than for the corresponding months of the ten years, 1877–1886. The average temperature was slightly lower in 1886 than the average for the

ten years 1877–86. It was also lower in each month of 1886 except in March, April and October, than the average in corresponding months in the ten years 1877–1886. The absolute humidity was less for the year and for each month of the year, except March and April, than the average for the ten years 1877–1886. The relative humidity was more for the year and for each month of the year, except in July, October, and November, than the average for the ten years 1877–1886.

The exact force of this evidence cannot yet be estimated, because of the change in method of reporting mentioned on a preceding page, but it can be held tentatively until the present method has been in operation long enough to settle the question.

EXHIBIT XII.—Pneumonia and Membranous Croup.—*Stating for the Year and for each Month of the Year 1886, what Per Cent of the Weekly Reports of Diseases Stated Presence of Pneumonia; also, of Membranous Croup, and what were the Meteorological Conditions, observed at Stations in Michigan.**

Pneumonia.				Temperature, F.		Humidity of Air.§ Av. of 3 Daily Observations.		Vapor inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces.		Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°.		Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure, Inches Reduced to 32° F.		
	Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Per Cent of Weekly Reports Stating Presence of.†	Average Order of Prevalence Where Present.††	Average Daily Range, by Registering Thermometers.	Average of 3 Daily Observations.	Relative Per Cent of Saturation.	Absolute—Grains of Vapor in a Cubic Foot of Air.	Inhaled.‖	Exhaled in Excess of that Inhaled.¶		Day Observation, 7 A. M. to 2 P. M.	Night Observation, 9 P. M. to 7 A. M.		Range. Monthly and for Year.	Range. Av. Daily, by 3 Daily Observations.**	Average Pressure.
More than Av. Pr. Cent of Pneumonia.	Mar..	52	3.8	*a*15.93	30.10	80	1.82	1.14	10.54	59	*a*2.89	3.63	10.1	1.339	.248	*a*29.126
	Feb..	46	3.7	*a*17.40	21.18	82	1.48	.93	10.75	68	*a*2.92	3.90	11.2	1.320	.324	29.198
	April	41	3.9	20.11	*b*46.04	*a*76	3.11	1.94	9.74	*a*53	*a*2.89	*a*3.26	*a*8.7	1.103	*a*.166	29.230
	Dec..	37	4.1	*a*15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
	Jan..	37	3.9	13.65	18.72	85	1.32	.83	10.85	80	*a*2.87	3.89	10.5	1.013	.270	*a*29.188
	May..	29	4.1	21.87	*b*54.69	*a*72	*b*3.82	2.39	9.29	*a*48	*a*2.91	*a*3.27	*a*8.4	*a*.728	*a*.157	*a*29.128
Average ...		27	4.0	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Pneumonia.	Nov..	22	4.4	15.11	*b*34.32	76	*b*2.02	1.26	10.42	*a*63	*a*3.30	*a*3.59	*a*12.0	*a*1.213	*a*.269	29.137
	June	19	3.7	*a*22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
	Oct..	13	4.7	*a*19.31	51.84	75	3.64	2.28	9.40	45	*a*3.14	*a*3.53	8.8	*a*1.406	*a*.229	*a*29.331
	Sept.	12	4.8	*a*18.83	61.15	*a*78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	*a*29.222
	July..	11	4.2	*a*22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
	Aug..	10	4.8	*a*19.77	67.36	75	5.75	3.59	8.09	43	*a*3.04	3.28	7.4	.597	.142	29.166
Membranous Croup.																
More than Av. Per Ct. of Mem. Croup.	Nov..	9	6.4	*a*15.11	34.32	*a*76	2.02	1.26	10.42	63	3.30	3.59	12.0	1.213	.269	*a*29.137
	Oct..	8	6.3	19.31	*b*51.84	*a*75	*b*3.64	2.28	9.40	*a*45	3.14	3.53	*a*8.8	1.406	.229	29.331
	Dec..	8	5.8	*a*15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
	Jan..	7	6.1	*a*13.65	18.72	85	1.32	.83	10.85	80	*a*2.87	3.89	10.5	1.013	.270	*a*29.188
	Feb..	6	4.5	*a*17.40	21.18	82	1.48	.93	10.75	68	*a*2.92	3.90	11.2	1.320	.324	29.198
Average ...		5	6.2	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Membranous Croup.	Sept.	5	6.8	*a*18.83	61.15	*a*78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	*a*29.222
	June	4	6.1	*a*22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
	Mar..	4	5.5	15.93	*b*30.10	*a*80	*b*1.82	1.14	10.54	*a*59	2.89	*a*3.63	*a*10.1	*a*1.339	*a*.248	29.126
	May..	4	6.8	*a*21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	.728	.157	29.128
	Apr..	3	5.9	*a*20.11	46.04	76	*b*3.11	1.94	9.74	53	2.89	3.26	8.7	*a*1.103	.166	*a*29.230
	Aug..	3	8.1	*a*19.77	67.36	75	5.75	3.59	8.09	43	*a*3.04	3.28	7.4	.597	.142	29.166
	July..	2	7.3	*a*22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159

*, †, ‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X., page 144.
a An exception to Proposition 1, relating to Pneumonia and Membranous Croup, on page 145.
b An exception to Proposition 2, relating to Pneumonia and Membranous Croup, on page 145.

EXHIBIT XIII.—*By Year and Months for 1886 and an Average for the Ten Years 1877-86,* Stating on what Per Cent of the Weekly Reports received* PNEUMONIA, MEMBRANOUS CROUP, DIPHTHERIA, RHEUMATISM, INFLUENZA, SCARLET FEVER, TONSILITIS,* AND NEURALGIA* *were Reported Present, and Comparing the Per Cents for Months in 1886 with the Averages for Corresponding Months in those years.*†

	Years, etc.	Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
Pneumonia.	Av. 10 years, 1877-86	37	58	63	61	54	39	25	16	13	17	21	33	45
	1885	27	50	58	60	50	31	19	11	10	12	17	22	31
	1886	27	37	46	52	41	29	19	11	10	12	13	22	37
	In 1886 **Greater** than Av. 1877-86	--	--	--	--	--	--	--	--	--	--	--	--	--
	In 1886 **Less** than Av. 1877-86	10	21	17	9	13	10	6	5	3	5	8	11	8
Membranous Croup.	Av. 10 years, 1877-86	6	12	10	8	7	5	4	2	3	4	6	9	10
	1885	5	16	10	10	6	3	3	2	1	3	3	5	5
	1886	5	7	6	4	3	4	4	2	3	5	8	9	8
	In 1886 **Greater** than Av. 1877-86	--	--	--	--	--	--	--	--	--	1	2	--	2
	In 1886 **Less** than Av. 1877-86	1	5	4	4	4	1	=	=	=	--	--	=	--
Diphtheria.	Av. 10 years, 1877-86	22	28	24	21	20	17	15	15	16	18	26	29	28
	1885	14	14	10	11	16	9	12	14	13	15	19	16	17
	1886	13	18	14	11	12	12	9	10	10	10	17	18	15
	In 1886 **Greater** than Av. 1877-86	--	--	--	--	--	--	--	--	--	--	--	--	--
	In 1886 **Less** than Av. 1877-86	9	10	10	10	8	5	6	5	6	8	9	11	13
Rheumatism.	Av. 10 years, 1877-86	69	73	73	75	75	71	68	62	57	61	67	72	74
	1885	68	73	76	82	79	74	71	63	59	60	64	70	70
	1886	70	68	71	78	76	74	70	63	62	65	69	72	73
	In 1886 **Greater** than Av. 1877-86	--	--	--	--	--	--	--	--	--	--	--	--	--
	In 1886 **Less** than Av. 1877-86	1	--	--	3	1	3	2	1	5	4	2	--	--
Influenza.	Av. 10 years, 1877-86	40	55	61	59	52	38	28	20	21	29	33	41	48
	1885	34	58	60	52	41	31	23	18	18	30	31	37	40
	1886	35	44	51	62	54	35	26	14	10	21	27	36	42
	In 1886 **Greater** than Av. 1877-86	--	--	--	3	2	--	--	--	--	--	--	--	--
	In 1886 **Less** than Av. 1877-86	5	11	10	--	--	3	2	6	11	8	6	5	6
Scarlatina.	Av. 10 years, 1877-86	18	22	24	24	22	20	17	14	12	13	16	17	18
	1885	12	16	18	14	13	13	15	13	8	7	13	11	11
	1886	11	11	12	17	12	13	13	7	6	7	12	9	13
	In 1886 **Greater** than Av. 1877-86	--	--	--	--	--	--	--	--	--	--	--	--	--
	In 1886 **Less** than Av. 1877-86	7	11	12	7	10	7	4	7	6	6	4	8	5
Tonsilitis.	Av. 8 years, 1879-86	49	60	61	60	53	47	42	33	32	37	45	55	60
	1885	50	63	58	61	53	50	43	38	37	42	48	58	60
	1886	49	62	63	63	54	44	39	32	31	39	44	52	61
	In 1886 **Greater** than Av. 1879-86	--	2	2	3	1	--	--	--	--	2	--	--	1
	In 1886 **Less** than Av. 1879-86	=	--	--	--	--	3	3	1	1	--	1	3	--
Neuralgia.	Av. 8 years, 1879-86	66	69	71	73	73	67	65	60	58	60	63	68	70
	1885	68	79	79	77	75	67	67	61	58	64	62	67	73
	1886	67	69	69	74	74	71	63	63	60	61	63	67	73
	In 1886 **Greater** than Av. 1879-86	1	=	--	1	1	4	--	3	2	1	=	--	3
	In 1886 **Less** than Av. 1879-86	--	--	2	--	--	--	2	--	--	--	--	1	--

* The average line for tonsilitis and neuralgia includes only the eight years, 1879-86.

† Other statements for 1886 and months in 1886 relative to these diseases are given in Table 2, pages 124-127, and in Exhibits XII, XIV, XV, and XVI, pages 147, 150, 151 and 152, where are also given for convenient comparison statements of coincident meteorological conditions. The lines for 1886 are graphically represented in Diagrams 1, page 113; 2, page 149, and 4 on a following page.

DIAGRAM 2.—WEEKLY REPORTS OF SICKNESS IN MICHIGAN, IN 1886.

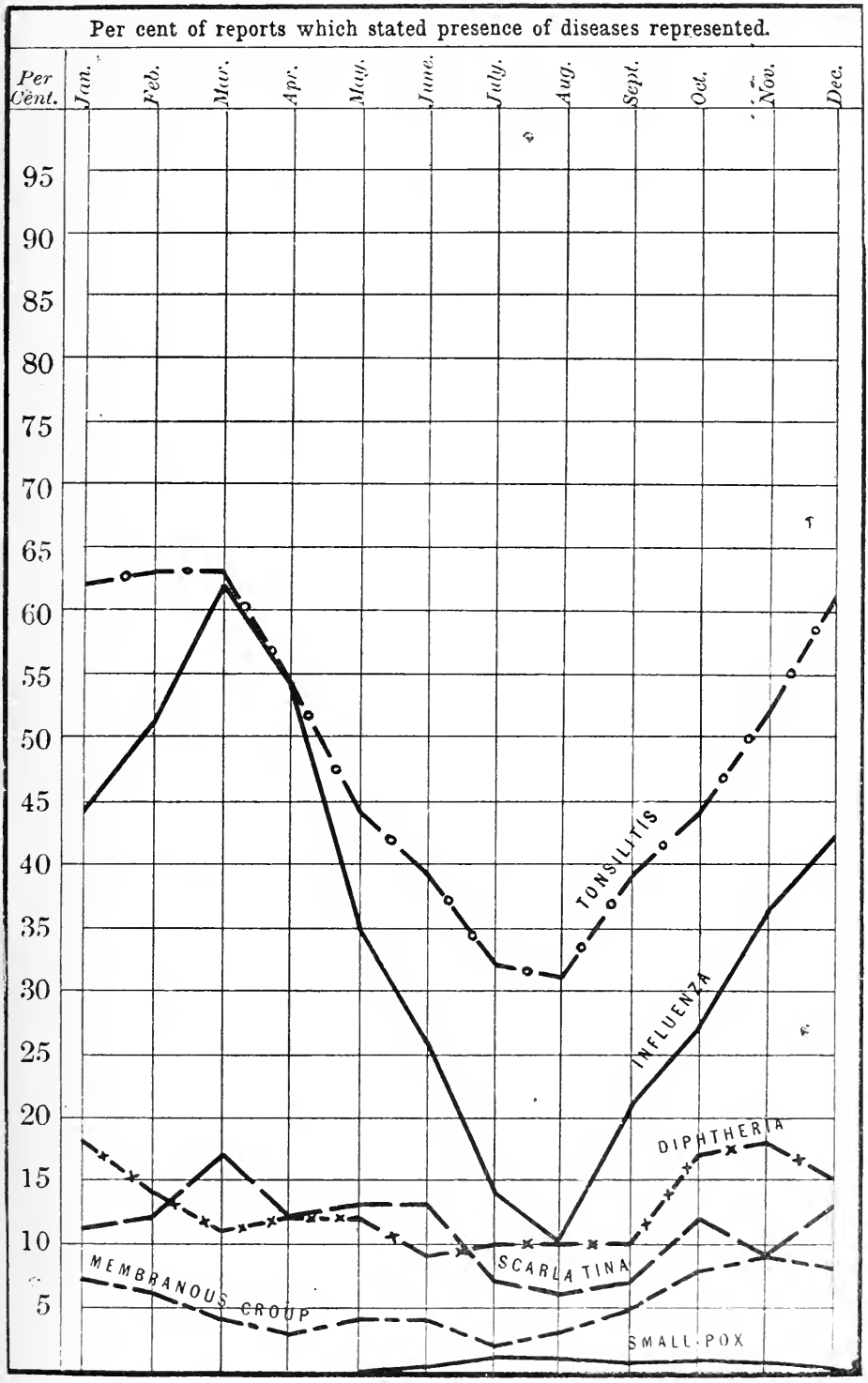


EXHIBIT XIV.—DIPHTHERIA AND TONSILITIS.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Diseases Stated Presence of Diphtheria, also, of Tonsilitis, and what were the Meteorological Conditions Observed at Stations in Michigan.**

Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Diphtheria. Per Cent of Weekly Reports Stating Presence of.†	Diphtheria. Average Order of Prevalence Where Present.†‡	Temperature, F. Average Daily Range, by Registering Thermometers.	Temperature, F. Average of 3 Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute—Grains of Vapor in a Cubic Foot of Air.	Vapor inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces. Inhaled, ‖	Vapor inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces. Exhaled in Excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°. Day Observation, 7 A. M. to 2 P. M.	Ozone—Relative Scale of 10°. Night Observation, 9 P. M. to 7 A. M.	Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure, Inches. Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure, Inches. Reduced to 32° F. Range. Av. Daily, by 3 Daily Observations.**	Atmospheric Pressure, Inches. Reduced to 32° F. Average Pressure.
More than Av. Per Ct. of Diphtheria.															
Jan.	18	4.2	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
Nov.	18	4.0	a15.11	34.32	a76	2.02	1.26	10.42	63	3.30	3.59	12.0	1.213	.269	a29.137
Oct.	17	3.7	19.31	b51.84	a75	b3.64	2.38	9.40	a45	3.14	3.53	a8.8	1.406	.229	29.331
Dec.	15	4.5	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
Feb.	14	4.2	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
Average	13	4.2	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Diphtheria.															
April.	12	3.9	a20.11	46.04	76	b3.11	1.94	9.74	53	2.89	3.26	8.7	a1.103	.166	a29.230
May	12	4.7	a21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	.728	.157	29.128
March.	11	5.2	15.93	b30.10	a80	b1.82	1.14	10.54	a59	2.89	a3.63	a10.1	a1.339	a.248	29.126
Aug.	10	4.4	a19.77	67.36	75	5.75	3.59	8.09	43	a3.04	3.28	7.4	.597	.142	29.166
Sept.	10	4.4	a18.83	61.15	a78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	a29.222
July	10	3.9	a22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
June	9	3.2	a22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
Tonsilitis.															
More than Av. Per Ct. of Tonsilitis.															
Feb.	63	3.1	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1 320	.324	29.198
March.	63	3.4	a15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.63	10.1	1.339	.248	a29.126
Jan.	62	3.2	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
Dec.	61	2.8	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
April.	54	3.4	20.11	b46.04	a76	3.11	1.94	9.74	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
Nov.	52	3.1	a15.11	34.32	a76	2.02	1.26	10.42	63	3.30	3.59	12.0	1.213	.269	a29.137
Average	49	3.4	18.53	44.82	77	c3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Ct. of Tonsilitis.															
May	44	3.5	a21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	.728	.157	29.128
Oct.	44	3.4	a19.31	51.84	75	3.64	2.28	9.40	45	a3.14	a3.53	8.8	a1.406	a.229	a29.331
Sept.	39	4.0	a18.83	61.15	a78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	a29.222
June	39	3.5	a22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
July	32	3.8	a22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
Aug.	31	4.2	a19.77	67.36	75	5.75	3.59	8.09	43	a3.04	3.28	7.4	.597	.142	29.166

*, †, ‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X., page 144.
a. An exception to Proposition 1, relating to Diphtheria and Tonsilitis, on page 145.
b. An exception to Proposition 2, relating to Diphtheria and Tonsilitis, on page 145.

EXHIBIT XV.—Influenza and Scarlet Fever.—*Stating for the Year and for each Month of the Year 1886, what Per Cent of the Weekly Reports of Sickness stated Presence of Influenza, also of Scarlet Fever, and what were the Meteorological Conditions observed at Stations in Michigan.*

Influenza.			Temperature, F.		Humidity of Air.§ Av. of 3 Daily Observations.		Vapor Inhaled and exhaled from the Air Passages by one Person in 24 Hours.—Troy Ounces.		Average Per Cent of Cloudiness.	Ozone.—Relative Scale of 10°.		Av. Velocity of Wind—Miles per Hour by Anemometer.	Atmospheric Pressure. Inches, Reduced to 32° F.		
Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Per Cent of Weekly Reports Stating Presence of.†	Av. Order of Prevalence where Present.‡‡	Av. Daily Range by Registering Thermometers.	Average of Three Daily Observations.	Relative Per Cent of Saturation.	Absolute,—Grs. of Vapor in a Cubic Foot of Air.	Inhaled.‖	Exhaled in excess of that Inhaled.¶		Day Observation, 7 A. M. to 2 P. M.	Night Observation, 9 P.M. to 7 A. M.		Range. Monthly, and for Year.	Range. Av. Daily, by 3 Daily Observations.**	Average Pressure.
More than Av. Per Cent of Influenza.															
March	62	1.8	a15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.65	10.1	1.339	.248	a29.126
April	54	2.2	20.11	b46.04	a76	3.11	1.94	9.94	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
Feb.	51	2.1	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
Jan.	44	2.4	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
Dec.	42	2.8	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
Nov.	36	2.8	a15.11	34.32	a76	2.02	1.26	10.42	63	3.30	3.59	12.0	1.213	.269	a29.137
Average.	35	2.7	18.53	44.82	77	c3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Influenza.															
May	35	2.8	a21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	.728	.157	29.128
Oct.	27	3.1	a19.31	51.84	75	3.64	2.28	9.40	45	a3.14	a3.53	8.8	a1.406	a.229	a29.331
June	26	2.9	a22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
Sept.	21	3.8	a18.83	61.15	a78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	a29.222
July	14	4.3	a22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
Aug.	10	4.9	a19.77	67.36	75	5.75	3.59	8.09	43	a3.04	3.28	7.4	.597	.142	29.166
Scarlet Fever.															
More than Average Per Cent of Scarlet Fever.															
March	17	5.0	15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.63	10.1	1.339	.248	a29 126
May	13	4.4	21.87	b54.69	a72	b3.82	2.39	9.29	a48	a2.91	a3.27	a8.4	a.728	a.157	a29.128
June	13	4.4	22.02	b63.31	a72	b4.98	3.11	8.57	a42	a2.89	a3.28	a7.3	a.600	a.131	a29.161
Dec.	13	4.8	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
Oct.	12	3.8	19.31	b51.84	a75	b3.64	2.28	9.40	a45	3.14	3.53	a8.8	1.406	.229	29.331
Feb.	12	3.3	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
April	12	4.3	20.11	b46.04	a76	3.11	1.94	9.74	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
Jan.	11	4.3	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
Average.	11	4.5	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Scarlet Fever															
Nov.	9	5.7	15.11	b34.32	76	b2.02	1.26	10.42	a63	a3.30	a3.59	a12.0	a1.213	a.269	29.137
July	7	4.7	a22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
Sept.	7	4.6	a18.83	61.15	a78	4.94	3.09	8 59	52	2.94	3.45	9.0	.717	.189	a29.222
Aug.	6	5.1	a19.77	67.36	75	5.75	3.59	8.09	43	a3.04	3.28	7.4	.597	.142	29.166

*, †‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X, page 144.
a. An exception to Proposition 1, relating to Influenza and Scarlet Fever, on page 145.
b. An exception to Proposition 2, relating to Influenza and Scarlet Fever, on page 145.

EXHIBIT XVI.—RHEUMATISM AND NEURALGIA.—*Stating for the Year and for each Month of the Year 1886 what Per Cent of the Weekly Report of Sickness Stated Presence of Rheumatism; also of Neuralgia; and what were the Meteorological Conditions observed at Station in Michigan.**

	Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Rheumatism. Per Cent of Weekly Reports Stating Presence of.†	Rheumatism. Average Order of Prevalence where Present.†,‡	Temperature, F. Average Daily Range by Registering Thermometers.	Temperature, F. Average of three Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute—Grains of Vapor in a Cubic Foot of Air.	Vapor Inhaled and Exhaled from Air Passages by one person in 24 hours. Troy Ounces. Inhaled.‖	Vapor Inhaled and Exhaled from Air Passages by one person in 24 hours. Troy Ounces. Exhaled, in excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone.—Relative Scale of 10°. Day Observation, 7 A. M. to 2 P. M.	Ozone.—Relative Scale of 10°. Night Observation, 9 P. M. to 7 A. M.	Average Velocity of Wind, Miles per hour by Anemometer.	Atmospheric Pressure, Inches. Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure, Inches. Reduced to 32° F. Range. Average Daily, by three Daily Observations.**	Atmospheric Pressure, Inches. Reduced to 32° F. Average Pressure.
More than Av. Per Cent of Rheumatism.	March	78	3.2	a15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.63	10.1	1.339	.248	29.126
	April	76	3.1	20.11	b46.04	a76	3.11	1.94	9.74	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
	May	74	3.0	21.87	b54.69	a72	b3.82	2.39	9.29	a48	a2.91	a3.27	a8.4	a.728	a.157	a29.128
	Dec.	73	3.0	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
	Nov.	72	3.1	a15.11	34.32	a76	2.02	1.26	10.42	63	3.30	3.59	12.0	1.213	.269	a29.137
	Feb.	71	2.9	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
	June	70	2.9	22.02	b63.31	a72	b4.98	3.11	8.57	a42	a2.89	a3.28	a7.3	a.600	a.131	a29.161
Average		70	3.2	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Ct. of Rheumatism.	Oct.	69	3.2	a19.31	51.84	75	3.64	2.28	9.40	45	a3.14	a3.53	8.8	a1.406	a.229	a29.331
	Jan.	68	2.9	13.65	b18.72	a85	b1.32	.83	10.85	a80	2.87	a3.89	a10.5	a1.013	a.270	29.188
	Sept.	65	3.7	a18.83	61.15	a78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	a29.222
	July	63	3.1	a22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
	Aug.	62	3.7	a19.77	67.36	75	5.75	3.59	8 09	43	a3.04	3.28	7.4	.597	.142	29.166
	NEURALGIA.															
More than Av. Per Ct. of Neuralgia.	April	74	2.8	20.11	b46.04	a76	3.11	1.94	9.74	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
	March	74	2.7	a15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.63	10.1	1.339	.248	a29.126
	Dec.	73	2.6	a15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	1.108	.220	29.262
	May	71	2.6	21.87	b54.69	a72	b3.82	2.39	9.29	a48	a2.91	a3.27	a8.4	a.728	a.157	a29.128
	Feb.	69	2.6	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
	Jan.	69	2.6	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
Average		67	2.8	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Ct. of Neuralgia.	Nov.	67	2.7	15.11	b34.32	76	b2.02	1.26	10.42	a63	a3.30	a3.59	a12.0	a1.213	a.269	29.137
	Oct.	63	2.7	a19.31	51.84	75	3.64	2.28	9.40	45	a3.14	a3.53	8.8	a1.406	a.229	a29.331
	June	63	2.4	a22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	.600	.131	29.161
	July	63	2.9	a22.94	68.68	71	5.59	3 49	8.19	36	2.51	2.88	7.0	.506	.112	29.159
	Sept.	61	3.4	a18.83	61.15	a78	4.94	3.09	8.59	52	2.94	3.45	9.0	.717	.187	a29.222
	Aug.	60	3.3	a19.77	67.36	75	5.75	3.59	8.09	43	a3.04	3.28	7.4	.597	.142	29.166

*, †, ‡, §, ‖, ¶, **. See footnotes with these marks in Exhibit X, page 144.

a. An exception to Proposition 1, relating to Rheumatism and Neuralgia, on page 145.

b. An exception to Proposition 2, relating to Rheumatism and Neuralgia, on page 145.

DIAGRAM 4.—WEEKLY REPORTS OF SICKNESS IN MICHIGAN, IN 1886.

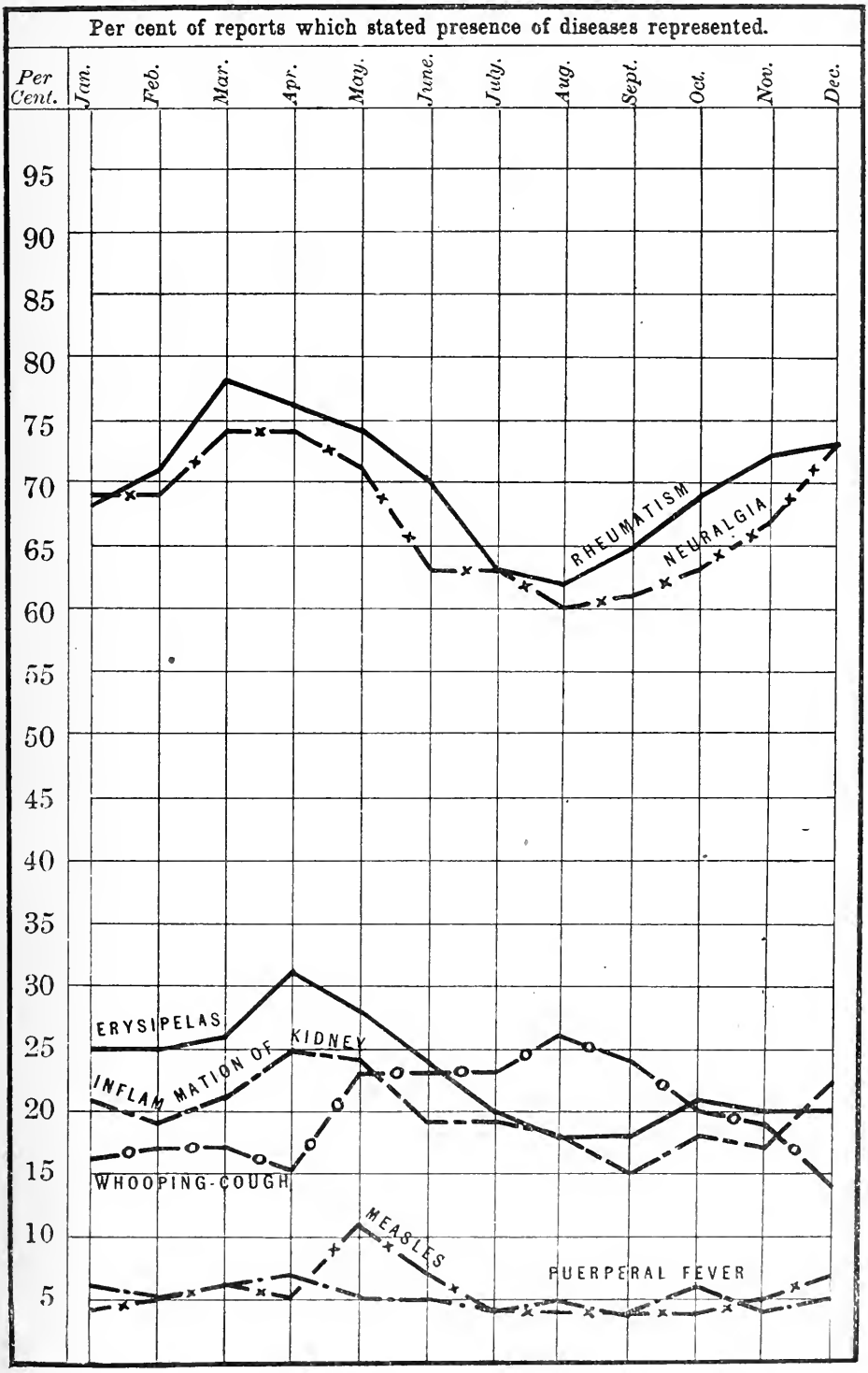


EXHIBIT XVII.—PULMONARY CONSUMPTION.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Sickness Stated Presence of Pulmonary Consumption, and what were the Meteorological Conditions Observed at Stations in Michigan.**

	Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Consumption. Per Cent of Weekly Reports Stating Presence of.†	Consumption. Average Order of Prevalence Where Present.†‡	Temperature, F. Average Daily Range, by Registering Thermometers.	Temperature, F. Average of 3 Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute — Grains of Vapor in a Cubic Foot of Air.	Vapor Inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces. Inhaled.‖	Vapor Inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces. Exhaled, in Excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°. Day Observation, 7 A. M. to 2 P. M.	Ozone—Relative Scale of 10°. Night Observation, 2 P. M. to 7 A. M.	Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure, Inches. Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure, Inches. Reduced to 32° F. Range. Av. Daily, by 3 Daily Observations.**	Atmospheric Pressure, Inches. Reduced to 32° F. Average Pressure.
More than Av. Per Ct. of Consumption.	Apr.	61	3.9	20.11	b46.04	a76	3.11	1.94	9.74	a53	a2.89	a3.26	a8.7	1.103	a.166	29.230
	Jan.	61	4.0	a13.65	18.72	85	1.32	.83	10.85	80	a2.87	3.89	10.5	1.013	.270	a29.188
	May	60	3.8	21.87	b54.69	a72	b3.82	2.39	9.29	a48	a2.91	a3.27	a8.4	a.728	a.157	a29.128
	March	60	4.1	a15.93	30.10	80	1.82	1.14	10.54	59	a2.89	3.63	10.1	1.339	.248	a29.126
	Feb.	58	4.1	a17.40	21.18	82	1.48	.93	10.75	68	a2.92	3.90	11.2	1.320	.324	29.198
	June	55	3.4	22.02	b63.31	a72	b4.98	3.11	8.57	a42	a2.89	a3.28	a7.3	a.600	a.131	a29.161
Average		55	3.6	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Consumption.	Nov.	55	3.7	15.11	b34.32	76	b2.02	1.26	10.42	a63	3.30	a3.59	a12.0	a1.213	a.269	29.137
	Dec.	54	3.8	15.44	b20.44	a82	b1.36	.85	10.83	a68	3.54	a3.60	a10.3	a1.108	a.220	a29.262
	Aug.	52	4.2	a19.77	67.36	75	5.75	3.59	8.09	43	3 04	3.28	7.4	.597	.142	29.166
	July	51	3.6	a22.94	68.68	71	5.59	3.49	8.19	36	a2.51	2.88	7.0	.506	.112	29.159
	Oct.	51	3.7	a19.31	51.84	75	3.64	2.28	9.40	45	3.14	a3.53	8.8	a1.406	a.229	a29.331
	Sept.	48	4.1	a18.83	61.15	a78	4.94	3.09	8.59	52	a2.94	3.45	9.0	a.717	.187	a29.222

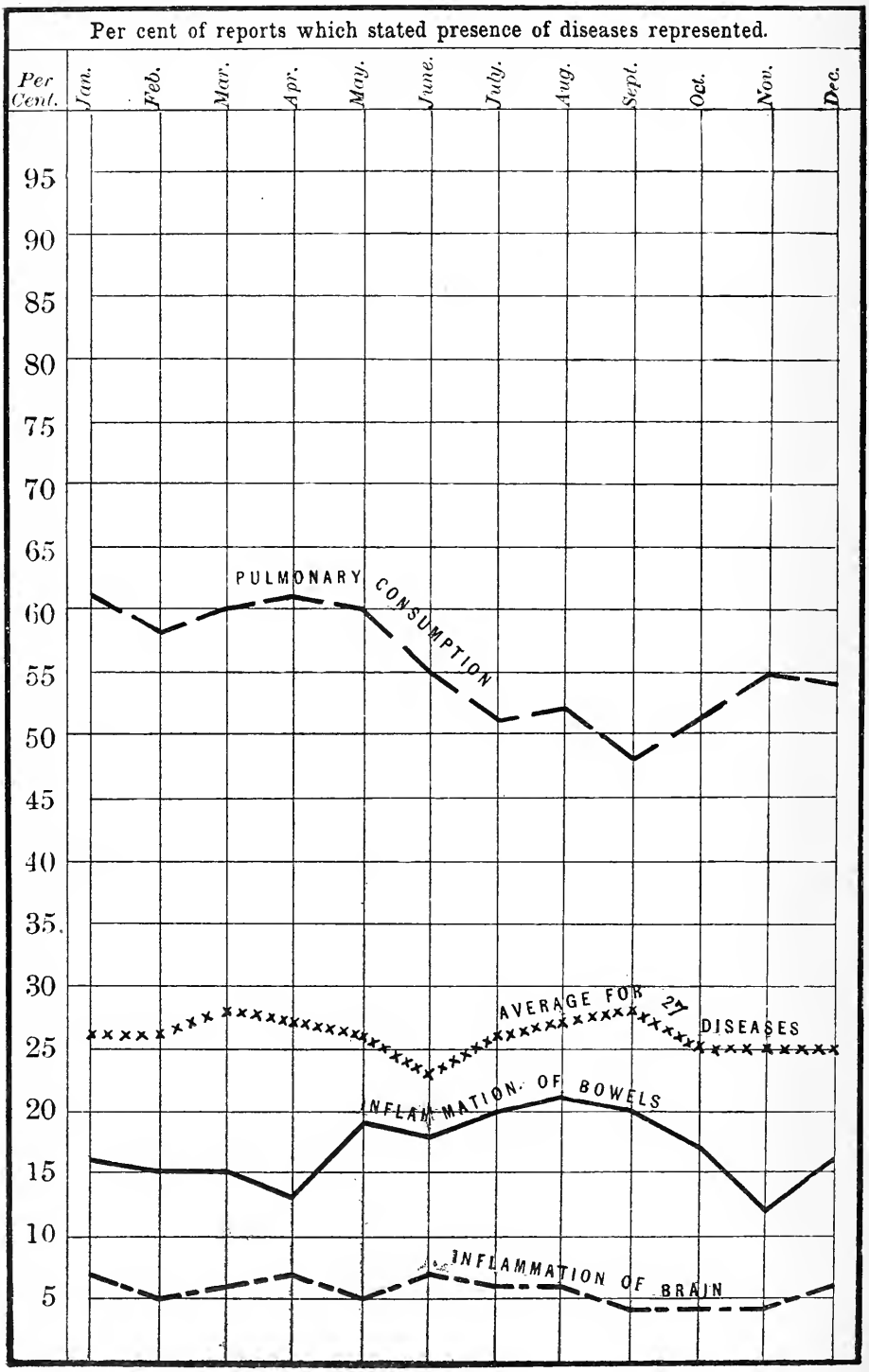
§, †, ‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X., page 144.
a. An exception to Proposition 1, relating to Consumption, on page 145.
b. An exception to Proposition 2, relating to Consumption. on page 145.

EXHIBIT XVIII.—SICKNESS FROM CONSUMPTION, 1877-86.—*By Year and Months for each of the Ten Years 1877-86, Stating on what Per Cent of the Weekly Reports received* CONSUMPTION *was Reported Present, and Comparing the Per Cents for 1886 with the Averages for Corresponding Months in those Years.*

Years, Etc.	Annual Av.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average for 9 Years, 1878-86*	65	65	68	69	70	67	65	63	61	62	64	64	63
1877*	52	50	47	47	53	49	50	43	35	38	34	68	65
1878	71	67	72	76	75	72	68	68	65	70	73	73	71
1879	70	71	71	69	77	74	73	69	67	67	69	67	64
1880	68	65	69	70	72	70	69	66	62	66	66	68	70
1881	71	74	76	73	76	69	68	67	67	70	73	74	67
1882	66	66	68	66	66	69	66	67	63	63	65	62	65
1883	61	69	66	66	65	62	61	59	55	57	58	58	60
1884	63	56	61	66	70	67	65	65	63	63	65	61	58
1885	58	60	68	71	69	58	61	56	52	54	55	56	56
1886	55	61	58	60	61	60	55	51	52	48	51	55	54
In 1886 **Greater** than Av. 1878-86	----	----	----	----	----	----	----	----	----	----	----	----	----
In 1886 **Less** than Av. 1878-86	10	4	10	9	9	7	10	12	9	14	13	9	9

* As consumption was not printed on the first blanks, nor on all used in 1877, that year is excluded from the average line.

DIAGRAM 5 —WEEKLY REPORTS OF SICKNESS IN MICHIGAN, IN 1886.



RELATIONS OF DIARRHEA TO METEOROLOGICAL CONDITIONS.

PROPOSITION 1.—That in months when **more** than the average per cent of weekly reports stated the presence of diarrhea, the average daily range of temperature, the average daily temperature, the absolute humidity of the atmosphere, the monthly and the average daily range of the barometer, and the average daily pressure of the atmosphere were **greater** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of diarrhea, these conditions were **less** than the average for the year. In Exhibit XIX, page 159, the letter *a* marks exceptions to this proposition for the year 1886.

Explanations of Propositions 1 and 2 are given on page 142, and a summary of the evidence in Exhibit XIX is given in Exhibit XX, on the following page.

PROPOSITION 2.—That in months when **more** than the average per cent of weekly reports stated the presence of diarrhea, the relative humidity of the atmosphere, the average per cent of cloudiness, the ozone, and the average velocity of the wind were **less** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of diarrhea, these conditions were **greater** than the average for the year. In Exhibit XIX, page 159, the letter *b* marks exceptions to this proposition for 1886.

PROPOSITION 3.—For those months which are not, as regards the absolute humidity of the atmosphere, exceptions to Proposition 1, it is true also that the quantity of vapor inhaled daily was **greater** than the average, and the quantity exhaled daily in excess of that inhaled was **less** than the average in months when **more** than the average per cent of reports stated presence of diarrhea; and that **less** vapor was inhaled and a **greater** excess exhaled daily in months when the per cent of reports stating presence of diarrhea was **less** than the average.

Proposition 3 is true also in relation to cholera infantum, intermittent fever, remittent fever, typhoid fever, typho-malarial fever, measles and whooping-cough, treated in Exhibits XIX, XXI, XXII, and XXIII, page 159, and following pages.

On what per cent of the weekly reports received, by months in the ten years, 1877–1886, the eight foregoing diseases were reported present is stated in Exhibit XX, page 160. In diagram 1, page 113, is graphically represented by months what per cent of the reports in each month in 1886 stated the presence of diarrhea.

The greatest sickness reported from diarrhea in 1886 was in the months of August, September, July and October. As shown in Exhibit XX, the reports indicated a slightly decreased prevalence of diarrhea in the year and in each of seven months of the year 1886. There was a slight increase in February and May.

In January, September and November the disease was equally prevalent with the average for the ten years 1877–1886.

The average temperature for the year and for each month of the year except in March, April and October, was slightly lower than the average for the ten years, 1877–1886. The absolute humidity for the year and for each month of the year except in March and April was less than the average for the ten years 1877–'86. The relative humidity was greater for the year and

for each month of the year, except in July, October and November, than the average for nine years 1878-1886.

RELATIONS OF CHOLERA INFANTUM AND OTHER "WARM WEATHER" DISEASES TO METEOROLOGICAL CONDITIONS.

PROPOSITION 1.—That in months when **more** than the average per cent of weekly reports stated the presence of cholera infantum (or of intermittent fever, remittent fever, typhoid fever, typho-malarial fever, measles, or whooping-cough), the average daily range of temperature, the average daily temperature, the absolute humidity of the atmosphere, the monthly and the average daily range of the barometer, and the average daily pressure of the atmosphere were **greater** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of cholera infantum (or of the other diseases named), these conditions were **less** than the average for the year. In Exhibit XIX, page 159, the letter *a* marks exceptions to this proposition for the year 1886.

Explanations of propositions 1 and 2 are given on page 142, and a summary of the evidence of Exhibit XIX is given in Exhibit XX, on a following page.

PROPOSITION 2.—That in months when **more** than the average per cent of weekly reports stated the presence of cholera infantum (or of intermittent fever, remittent fever, typhoid fever, typho-malarial fever, measles, or whooping-cough), the relative humidity of the atmosphere, the average per cent of cloudiness, the ozone, and the average velocity of the wind were **less** than the average for the year; and that in months when **less** than the average per cent of reports stated the presence of cholera infantum (or of the other diseases named), these conditions were **greater** than the average for the year. In Exhibit XIX, page 159, the letter *b* marks exceptions to this proposition for 1886.

What per cent of all the weekly reports of sickness in each month in 1886 stated the presence of cholera infantum is graphically represented by months in diagram 1, page 113. What per cent of the reports received by months in the ten years 1877-86, stated presence of cholera infantum and of the other diseases mentioned in Propositions 1 and 2, is stated in Exhibit XX, page 160.

As in preceding years, cholera infantum was most prevalent during and immediately following the hot months—August, September, July and October being for 1886 the months in which more than the average sickness from this disease was reported. Exhibit XXV shows exactly the same exceptions to propositions relating to meteorological conditions in both diarrhea and cholera infantum. This is true, of course, with any two or more diseases in which the months above the average line are exactly the same.

EXHIBIT XIX.—DIARRHEA AND CHOLERA INFANTUM.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Sickness Stated Presence of Diarrhea; also of Cholera Infantum, and what were the Meteorological Conditions observed at Stations in Michigan.**

Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Diarrhea. Per Cent of Weekly Reports Stating Presence of.†	Diarrhea. Av. Order of Prevalence where Present.† ‡	Temperature, F. Average Daily Range, by Registering Thermometers.	Temperature, F. Average of 3 Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute—Grains of Vapor in a Cubic Foot of Air.	Vapor Inhaled and Exhaled from the Air-Passages by one Person in 24 Hours. Troy Ounces. Inhaled.‖	Vapor Inhaled and Exhaled from the Air-Passages by one Person in 24 Hours. Troy Ounces. Exhaled, in Excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°. Day Observation, 7 A. M. to 9 P. M.	Ozone—Relative Scale of 10°. Night Observation, 9 P. M. to 7 A. M.	Average Velocity of Wind, Miles per Hour, by Anemometer.	Atmospheric Pressure. Inches, Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure. Inches, Reduced to 32° F. Range. Average Daily, by 3 Daily Observations.**	Atmospheric Pressure. Inches, Reduced to 32° F. Average Pressure.
More than Av. Per Cent of Diarrhea.															
Aug.	82	1.8	19.77	67.36	75	5.75	3.59	8.09	43	*b*3.04	3.28	7.4	*a*.597	*a*.142	*a*29.166
Sept.	81	1.9	18.83	61.15	*b*78	4.94	3.09	8.59	52	2.94	3.45	9.0	*a*.717	*a*.187	29.222
July	66	2.3	22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	*a*.506	*a*.112	*a*29.159
Oct.	51	2.7	19.31	51.84	75	3.64	2.28	9.40	45	*b*3.14	*b*3.53	8.8	1.406	.229	29.331
Average	45	3.2	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Diarrhea.															
June	40	3.3	*a*22.02	*a*63.31	*b*72	*a*4.98	3.11	8.57	*b*42	*b*2.89	*b*3.28	*b*7.3	.600	.131	29.161
May	38	3.9	*a*21.87	*a*54.69	*b*72	*a*3.82	2.39	9.29	*b*48	*b*2.91	*b*3.27	*b*8.4	.728	.157	29.128
Nov.	36	3.8	15.11	34.32	*b*76	2.02	1.26	10.42	63	3.30	3.59	12.0	*a*1.213	*a*.269	29.137
Feb.	31	4.6	17.40	21.18	82	1.48	.93	10.75	68	*b*2.92	3.90	11.2	*a*1.320	*a*.324	*a*29.198
April	31	4.2	*a*20.11	*a*46.04	*b*76	3.11	1.94	9.74	*b*53	*b*2.89	*b*3.26	*b*8.7	*a*1.103	.166	*a*29.230
Jan.	27	4.3	13.65	18.72	85	1.32	.83	10.85	80	*b*2.87	3.89	10.5	*a*1.013	*a*.270	29.188
Dec.	27	4.0	15.44	20.44	82	1.36	.85	10 83	68	3.54	3.60	10.3	*a*1.108	*a*.220	*a*29.262
March	25	4.9	15 93	30.10	80	1.82	1.14	10.54	59	*b*2.89	3.63	10.1	*a*1.339	*a*.248	29.126
CHOLERA INFANTUM.															
More than Av. Pr. Ct. of Cholera Infantum.															
Aug.	47	3.1	19.77	67.36	75	5.75	3.59	8.09	43	*b*3.04	3.28	7.4	*a*.597	*a*.142	*a*29.166
Sept.	42	3.4	18.83	61.15	*b*78	4.94	3.09	8.59	52	2.94	3.45	9.0	*a*.717	*a*.187	29 222
July	29	3.6	22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	*a*.506	*a*.112	*a*29.159
Oct.	17	4.4	19.31	51.84	75	3.64	2.28	9.40	45	*b*3.14	*b*3.53	8.8	1.406	.229	29.331
Average	14	3.9	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Average Per Cent of Cholera Infantum.															
June	10	4.7	*a*22.02	*a*63.31	*b*72	*a*4.98	3.11	8.57	*b*42	*b*2.89	*b*3.28	*b*7.3	.600	.131	29.161
May	5	6.3	*a*21.87	*a*54.69	*b*72	*a*3.82	2.39	9.29	*b*48	*b*2.91	*b*3.27	*b*8.4	.728	.157	29.128
Nov.	5	6.4	15.11	34.32	*b*76	2.02	1.26	10.42	63	3.30	3.59	12.0	*a*1.213	*a*.269	29.137
April	2	5.2	*a*20.11	*a*46.04	*b*76	3.11	1.94	9.74	*b*53	*b*2.89	*b*3.26	*b*8.7	*a*1.103	.166	*a*29.230
Dec.	2	3.8	15.44	20.44	82	1 36	.85	10.83	68	3.54	3.60	10.3	*a*1.108	*a* 220	*a*29.262
March	2	7.0	15.93	30.10	80	1.82	1.14	10 54	59	*b*2.89	3.63	10.1	*a*1.339	*a*.248	29.126
Jan.	1	6.3	13.65	18.72	85	1.32	.83	10.85	80	*b*2.87	3 89	10.5	*a*1.013	*a*.270	29.188
Feb.	1	7.0	17.40	21.18	82	1.48	.93	10.75	68	*b*2.92	3 90	11.2	*a*1.320	*a*.324	*a*29.198

*, †, ‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X., page 144.
a. An exception to Proposition 1, relating to Diarrhea and Cholera Infantum, on page 158.
b. An exception to Proposition 2, relating to Diarrhea and Cholera Infantum, on page 158.

EXHIBIT XX.—*By Year and Months for 1886 and an Average for the Ten Years 1877-86, Stating on what Per Cent of the Weekly Reports received* DIARRHEA, CHOLERA INFANTUM, INTERMITTENT FEVER, REMITTENT FEVER, TYPHOID FEVER, TYPHO-MALARIAL FEVER, MEASLES, *and* WHOOPING-COUGH *were Reported Present, and Comparing the Per Cents for 1886 with the Averages for Corresponding Months in those Years.**

	Years, Etc.	Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Diarrhea.	Av. 10 years, 1877-1886	47	27	28	29	32	37	45	73	85	81	56	36	28
	1885	46	26	31	35	33	36	44	65	77	65	44	33	27
	1886	45	27	31	25	31	38	40	66	82	81	51	36	27
	In 1886 **Greater** than Av. 1877-1886	..	..	3	..	..	1	..	..	..	..	..	..	..
	In 1886 **Less** than Av. 1877-86	2	=	..	4	1	..	5	7	3	=	5	=	1
Cholera Infantum.	Av. 10 years, 1877-1886	13	2	2	2	2	3	10	31	48	36	14	4	2
	1885	11	3	1	1	2	5	7	22	35	18	8	4	2
	1886	14	1	1	2	2	5	10	29	47	42	17	5	2
	In 1886 **Greater** than Av. 1877-1886	1	..	..	..	..	2	..	..	..	6	3	1	..
	In 1886 **Less** than Av. 1877-86	..	1	1	=	=	..	=	2	1	..	..	..	=
Intermittent Fever.	Av. 10 years, 1877-86	72	58	60	63	72	78	80	82	81	81	79	70	61
	1885	59	51	52	51	57	64	68	67	65	65	60	55	49
	1886	54	47	49	50	61	57	61	61	60	58	57	48	41
	In 1886 **Greater** than Av. 1877-86	..	..	..	..	..	..	..	..	..	..	..	..	..
	In 1886 **Less** than Av. 1877-86	18	11	11	13	11	21	19	21	21	23	22	22	20
Remittent Fever.	Av. 10 years, 1877-86	48	40	39	41	44	47	48	51	57	60	58	48	42
	1885	36	33	32	43	38	33	35	32	39	40	39	38	31
	1886	34	33	29	34	34	35	36	36	36	36	33	34	27
	In 1886 **Greater** than Av. 1877-86	..	..	..	..	..	..	..	..	..	..	..	..	..
	In 1886 **Less** than Av. 1877-86	14	7	10	7	10	12	12	15	21	24	25	14	15
Typhoid Fever.	Av. 10 years, 1877-86	12	11	8	7	6	5	6	7	13	20	22	21	15
	1885	8	11	7	5	4	3	5	5	6	11	13	16	8
	1886	8	6	3	4	3	5	4	5	13	16	16	13	10
	In 1886, **Greater** than Av. 1877-86	..	..	..	..	..	..	..	..	..	..	..	..	..
	In 1886, **Less** than Av. 1877-86	4	5	5	3	3	=	2	2	=	4	6	8	5
Typho-malarial Fever.	Av. 10 years, 1877-86	22	18	15	14	12	12	12	16	25	40	43	33	22
	1885	16	15	16	14	10	11	10	10	15	24	25	21	14
	1886	16	10	9	12	9	11	10	14	18	27	25	24	15
	In 1886, **Greater** than Av. 1877-86	..	..	..	..	..	..	..	..	..	..	..	..	..
	In 1886, **Less** than Av. 1877-86	6	8	6	2	3	1	2	2	7	13	18	9	7
Measles.	Av. 10 years, 1877-86	13	10	13	16	21	26	21	14	7	5	5	6	7
	1885	5	4	7	10	10	9	7	8	2	2	1	3	3
	1886	6	4	5	6	5	11	7	4	4	4	4	5	7
	In 1886, **Greater** than Av. 1877-86	..	..	..	..	..	..	..	..	..	..	..	..	..
	In 1886, **Less** than Av. 1877-86	7	6	8	10	16	15	14	10	3	1	1	1	=
Whooping-cough.	Av. 10 years, 1877-86	20	20	20	20	17	19	20	22	23	22	19	20	19
	1885	14	18	16	20	17	9	10	14	16	16	15	14	13
	1886	20	16	17	17	15	23	23	23	26	24	20	19	14
	In 1886, **Greater** than Av. 1877-86	..	..	..	..	..	4	3	1	3	2	1	..	..
	In 1886, **Less** than Av. 1877-86	=	4	3	3	2	..	..	..	..	..	..	1	5

* Other statements for 1886 and months in 1886, relative to these diseases, are given in Table 2, pages 124-133, and in Exhibits XIX, XXI, XXII, and XXIII, pages 159, 161, 163 and 164, where are also given for convenient comparison statements of coincident meteorological conditions. The lines for 1886 are graphically represented in Diagrams 1, page 113; 3, page 162, and 4, page 153.

EXHIBIT XXI.—INTERMITTENT FEVER AND REMITTENT FEVER.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Diseases Stated Presence of Intermittent Fever; also Remittent Fever, and what were the Meteorological Conditions, Observed at Stations in Michigan.**

	Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Per Cent of Weekly Reports Stating Presence of.†	Av. Order of Prevalence where Present.†‡	Temperature, F. Av. Daily Range, by Registering Thermometers.	Temperature, F. Av. of three Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute—Grains of Vapor in a Cubic Foot of Air.	Vapor Inhaled and exhaled from the Air Passages by one Person in 24 Hours. Troy Ounces. Inhaled.‖	Vapor Inhaled and exhaled from the Air Passages by one Person in 24 Hours. Troy Ounces. Exhaled in Excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°. Day Observation, 7 A. M. to 2 P. M.	Ozone—Relative Scale of 10°. Night Observation, 9 P. M. to 7 A. M.	Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure. Inches. Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure. Inches. Reduced to 32° F. Range. Av. Daily by 3 Daily Observations.**	Atmospheric Pressure. Inches. Reduced to 32° F. Average Pressure.
INTERMITTENT FEVER.																
More than Average Per Cent of Intermittent Fever.	July	61	2.3	22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	a.506	a.112	a29.159
	June	61	2.0	22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	a.600	a.131	a29.161
	April	61	2.7	20.11	46.04	76	a3.11	1.94	9.74	53	2.89	3.26	8.7	1.103	a.166	29.230
	Aug.	60	2.5	19.77	67.36	75	5.75	3.59	8.09	43	b3.04	3.28	7.4	a.597	a.142	a29.166
	Sept.	58	2.6	18.83	61.15	b78	4.94	3.09	8.59	52	2.94	3.45	9.0	a.717	a.187	29.222
	May	57	2.6	21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	a.728	a.157	a29.128
	Oct.	57	2.3	19.31	51.84	75	3.64	2.28	9.40	45	b3.14	b3.53	8.8	1.406	.229	29.331
Average		54	2.6	18.53c	44.82c	77	3.32	2.08	9.60	55c	2.99	3.46	9.2c	.941	.205	29.192
Less than Av. Per Cent of Intermittent Fever.	March	50	3.1	15.93	30.10	80	1.82	1.14	10.51	59	b2.89	3.63	10.1	a13.39	a.248	a.126
	Feb.	49	3.2	17.40	21.18	82	1.48	.93	10.75	68	b2.92	3.90	11.2	a1.320	a.324	a29.198
	Nov.	48	2.7	15.11	34.32	b76	2.02	1.26	10.42	63	3.30	3.59	12.0	a1.213	a.269	29.137
	Jan.	47	3.2	13.65	18.72	85	1.32	.83	10.85	80	b2.87	3.89	10.5	a1.013	a.290	29.188
	Dec.	41	2.9	15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10 3	a1.108	a.220	a29.262
REMITTENT FEVER.																
More than Average Per Cent of Remittent Fever.	July	36	2.9	22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	a.506	a.112	a29.159
	June	36	2.7	22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	a.600	a.131	a29.161
	Sept.	36	3.0	18.83	61.15	b78	4.94	3.09	8.59	52	2.94	3.45	9.0	a.717	a.187	29.222
	Aug.	36	3.3	19.77	67.36	75	5.75	3.59	8.09	43	b3.04	3.28	7.4	a.597	a.142	a29.166
	May	35	3.5	21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	a.728	a.157	a29.128
	March	34	3.9	a15.93	a30.10	b80	a1.82	1.14	10.54	b59	2.89	b3.63	b10.1	1.339	.248	a29.126
	Nov.	34	3.4	a15.11	a34.32	76	a2.02	1.26	10.42	b63	b3.30	b3.59	b12.0	1.213	.269	a29.137
	April	34	3.6	20.11	46.04	76	a3.11	1.94	9.74	53	2.89	3.26	8.7	1.103	a.166	29.230
Average		34	3.3	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Pr. Ct. of Remittent Fever.	Oct.	33	2.8	a19.31	a51.84	b75	a3.64	2.28	9.40	b45	3.14	3.53	b8.8	a1.406	a.229	a29.331
	Jan.	33	3.8	13.65	18.72	85	1.32	.83	10.85	80	b2.87	3.89	10.5	a1.013	a.270	29.188
	Feb.	29	3.8	17.40	21.18	82	1.48	.93	10.75	68	b2.92	3.90	11.2	a1.320	a.324	a29.198
	Dec.	27	3.7	15 44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	a1.108	a.220	a29.262

*, †, ‡, §, ‖, ¶, **. See foot notes with these marks in Exhibit X., page 144.
a. An exception to Proposition 1, relating to Intermittent Fever and Remittent Fever, on page 158.
b. An exception to Proposition 2, relating to Intermittent Fever and Remittent Fever, on page 158.

DIAGRAM 3.—WEEKLY REPORTS OF SICKNESS IN MICHIGAN, IN 1886.

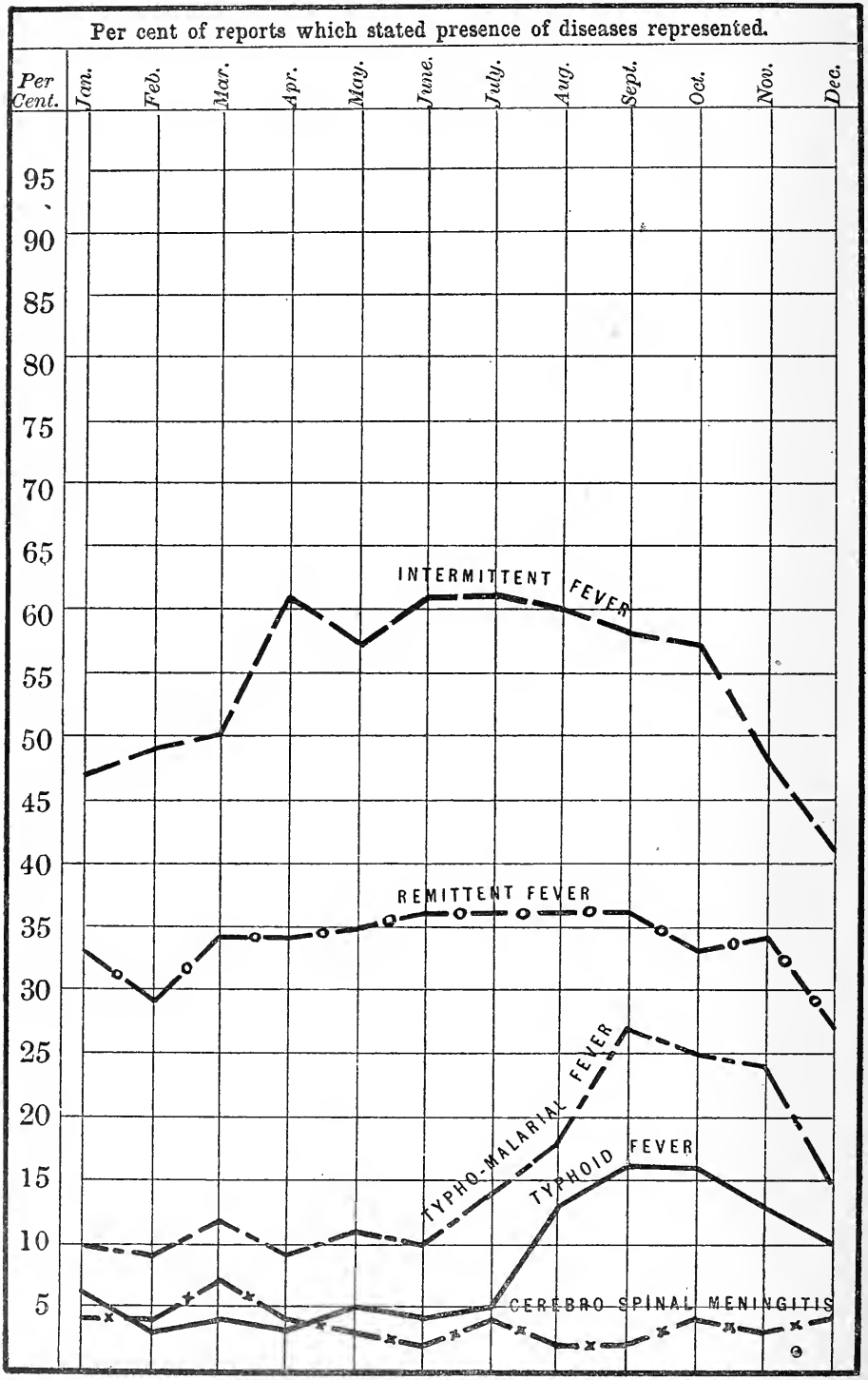


EXHIBIT XXII.—Typhoid Fever and Typho-malarial Fever.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Diseases Stated Presence of Typhoid Fever; also of Typho-malarial Fever, and what were the Meteorological Conditions observed at Stations in Michigan.**

Typhoid Fever.				Temperature, F.		Humidity of Air.§ Av. of 3 Daily Observations.		Vapor inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces.		Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°.		Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure, Inches. Reduced to 32° F.		
Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Per Cent of Weekly Reports Stating Presence of.†	Average Order of Prevalence Where Present.† ‡		Average Daily Range, by Registering Thermometers.	Average of 8 Daily Observations.	Relative Per Cent of Saturation.	Absolute—Grains of Vapor in a Cubic Foot of Air.	Inhaled.‖	Exhaled in Excess of that Inhaled.¶		Day Observation, 7 A. M. to 2 P. M.	Night Observation, 9 P. M. to 7 A. M.		Range. Monthly and for Year.	Range. Av. Daily, by 3 Daily Observations.**	Average Pressure.
More than Av. Per Cent of Typhoid F.																
Oct.	16	3.8		19.31	51.84	75	3.64	2.28	9.40	45	*b*3.14	*b*3.53	8.8	1.406	.229	29.331
Sept.	16	4.2		18.83	61.15	*b*78	4.94	3.09	8.59	52	2.94	3.45	9.0	*a*.717	*a*.187	29.222
Nov.	13	4.6		*a*15.11	*a*34.32	76	*a*2.02	1.26	10.42	*b*63	*b*3.30	*b*3.59	*b*12.0	1.213	.269	*a*29.137
Aug.	13	4.1		19.77	67.36	75	5.75	3.59	8.09	43	*b*3.04	3.28	7.4	*a*.597	*a*.142	*a*29.166
Dec.	10	4.6		*a*15.44	*a*20.44	*b*82	*a*1.36	.85	10.83	*b*68	*b*3.54	*b*3 60	*b*10.3	1.108	.220	29.262
Average	8	4.7		18.53	44.82	77	3.32	2 08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Typhoid Fever.																
Jan.	6	6.6		13.65	18.72	85	1.32	.83	10.85	80	*b*2.87	3.89	10.5	*a*1.013	*a*.270	29.188
July	5	4.9		*a*22.94	*a*68.68	*b*71	*a*5.59	3.49	8.19	*b*36	*b*2 51	*b*2.88	*b*7.0	.506	.112	29.159
May	5	5.4		*a*21.87	*a*54.69	*b*72	*a*3.82	2.39	9.29	*b*48	*b*2.91	*b*3 27	*b*8.4	.728	.157	29.128
Mar.	4	6.0		15.93	30.10	80	1.82	1.14	10.54	59	*b*2.89	3.63	10.1	*a*1.339	*a*.248	29.126
June	4	6.1		*a*22.02	*a*62.31	*b*72	*a*4.98	3.11	8.57	*b*42	*b*2.89	*b*3.28	*b*7.3	.600	.131	29.161
Feb.	3	6.8		17.40	21.18	82	1.48	.93	10 75	68	*b*2.92	3.90	11.2	*a*1.320	*a*.324	*a*29.195
Apr.	3	7.0		*a*20.11	*a*46.04	*b*76	3.11	1.94	9.74	*b*53	*b*2.89	*b*3.26	*b*8.7	*a*1.103	.166	*a*29.230
Typho-Malarial Fever.																
More than Av. Per Cent of Typho-mal. F.																
Sept.	27	4.1		18.83	61.15	*b*78	4.94	3.09	8.59	52	2.94	3.45	9.0	*a*.717	*a*.187	29.222
Oct.	25	3.8		19.31	51.84	75	3.61	2.28	9.40	45	*b*3.14	*b*3.53	8.8	1.406	.229	29.331
Nov.	24	3.8		*a*15.11	*a*34.32	76	*a*2.02	1.26	10.42	*b*63	*b*3.30	*b*3.59	*b*12.0	1.213	.269	*a*29.157
Aug.	18	4.2		19.77	67.36	75	5.75	3.59	8.09	43	*b*3.04	3.28	7.4	*a*.597	*a*.142	*a*29.166
Average	16	4.2		18.53	44.82	77	3.32	2.08	9.60	55	2 99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Typho-malarial Fever.																
Dec.	15	3.8		15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	*a*1.108	*a*.220	*a*29.262
July	14	4.2		*a*22.94	*a*68.68	*b*71	*a*5.59	3.49	8.19	*b*36	*b*2.51	*b*2.88	*b*7.0	.506	.112	29.159
Mar.	12	4.5		15.93	30.10	80	1.82	1.14	10.54	59	*b*2.89	*b*3.63	10.1	*a*1.339	*a*.248	29.126
May	11	4.3		*a*21.87	*a*54.69	*b*72	*a*3.82	2.39	9.29	*b*4	*b*2.91	3.27	*b*8.4	.728	.157	29.128
June	10	4.5		*a*22.02	*a*63.31	*b*72	*a*4.98	3.11	8.57	*b*42	*b*2.89	3.28	*b*7.3	.600	.131	29.161
Jan.	10	4.8		13.65	18.72	85	1.32	.83	10.85	80	*b*2.87	*b*3.89	10.5	*a*1.013	*a*.270	29.188
Feb.	9	4.6		17.40	21.18	82	1.48	.93	10.75	68	*b*2.92	*b*3.90	11.2	*a*1.320	*a*324	*a*29.198
April	9	4.7		*a*20.11	*a*46.04	*b*76	3.11	1.91	9.74	53	*b*2.89	3.26	*b*8.7	*a*1.103	.166	*a*29.230

*, †, ‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X., page 144.
a An exception to Proposition 1, relating to Typhoid and Typho-malarial Fever, on page 158.
b An exception to Proposition 2, relating to Typhoid and Typho-malarial Fever, on page 158.

EXHIBIT XXIII.—MEASLES AND WHOOPING-COUGH.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Diseases Stated Presence of Measles; also of Whooping-cough, and what were the Meteorological Conditions Observed at Stations in Michigan.**

Measles.	Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.	Per Cent of Weekly Reports Stating Presence of. †	Av. Order of Prevalence Where Present. †‡	Temperature, F. Av. Daily Range, by Registering Thermometers.	Temperature, F. Av. of three Daily Observations.	Humidity of Air.§ Av. of 3 Daily Observations. Relative Per Cent of Saturation.	Humidity of Air.§ Av. of 3 Daily Observations. Absolute—Grains of Vapor in a Cubic Foot of Air.	Vapor inhaled and exhaled from the Air Passages by one Person in 24 Hours. Troy Ounces. Inhaled.‖	Vapor inhaled and exhaled from the Air Passages by one Person in 24 Hours. Troy Ounces. Exhaled in Excess of that Inhaled.¶	Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°. Day Observation, 7 A. M. to 2 P. M.	Ozone—Relative Scale of 10°. Night Observation, 9 P. M. to 7 A. M.	Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure. Inches Reduced to 32° F. Range. Monthly and for Year.	Atmospheric Pressure. Inches Reduced to 32° F. Range. Average Daily by 3 Daily Observations.**	Atmospheric Pressure. Inches Reduced to 32° F. Average Pressure.
More than Av. Per Cent of Measles.	May	11	3.7	21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	*a*.728	*a*.157	*a*29.128
	Dec.	7	5 3	*a*15.41	*a*20.44	*b*82	*a*1.36	.85	10.83	*b*68	*b*3.54	*b*3.60	*b*10.3	1.108	.220	29.262
	June	7	4.7	22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	*a*.600	*a*.131	*a*29.161
	March.	6	5.2	*a*15.93	*a*30.10	*b*80	*a*1.82	1.14	10.54	*b*59	2.89	*b*3.63	*b*10.1	1.339	.248	*a*29.126
Average		6	5.0	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Measles.	April	5	3.6	*a*20.11	*a*46.04	*b*76	3.11	1.94	9.74	*b*53	*b*2.89	*b*3.26	*b*8.7	*a*1.103	.166	*a*29.230
	Feb.	5	5.2	17.40	21.18	82	1.48	.93	10.75	68	*b*2.92	3.90	11.2	*a*1.320	*a*.324	*a*29.198
	Nov.	5	4.6	15.11	34.32	*b*76	2.02	1.26	10.42	63	3.30	3.59	12.0	*a*1 213	*a*.269	29.137
	Aug.	4	6.4	*a*19.77	*a*67,36	*b*75	*a*5.75	3.59	8.09	*b*43	3.04	*b*3.28	*b*7.4	.597	.142	29.166
	Sept.	4	5.9	*a*18.83	*a*61.15	78	*a*4.94	3.09	8.59	*b*52	*b*2.94	*b*3.45	*b*9.0	.717	.187	*a*29.222
	July	4	6.0	*a*22.94	*a*68.68	*b*71	*a*5.59	3.49	8.19	*b*36	*b*2.51	*b*2.88	*b*7.0	.506	.112	29.159
	Oct.	4	4.6	*a*19.31	*a*51.84	*b*75	*a*3.64	2.28	9.40	*b*45	3.14	3.53	*b*8.8	*a*1.406	*a*.229	*a*29.331
	Jan.	4	5.8	13.65	18.72	85	1.32	.83	10.85	80	*b*2.87	3.89	10.5	*a*1.013	*a*.270	29.188
Whooping-Cough.																
More than Av. Pr. Ct. of Whooping-Cough.	Aug.	26	3.7	19.77	67.36	75	5.75	3.59	8.09	43	*b*3.04	3.28	7.4	*a*.597	*a*.142	*a*29.166
	Sept.	24	3.6	18.83	61.15	*b*78	4.94	3.09	8.59	52	2.94	3.45	9.0	*a*.717	*a*.187	29.222
	July	23	3.4	22.94	68.68	71	5.59	3.49	8.19	36	2.51	2.88	7.0	*a*.506	*a*.112	*a*29.159
	May	23	3.6	21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	*a*.728	*a*.157	*a*29.128
	June	23	3.7	22.02	63.31	72	4.98	3.11	8.57	42	2.89	3.28	7.3	*a*.600	*a*.131	*a*29.161
Average		20	3.7	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Per Cent of Whooping-Cough.	Oct.	20	4.1	*a*19.31	*a*51.84	*b*75	*a*3.64	2.28	9.48	*b*45	3.14	3.53	*b*8.8	*a*1.406	*a*.229	*a*29.331
	Nov.	19	4.1	15.11	34.32	*b*76	2.02	1.26	10.42	63	3.30	3.59	12.0	*a*1.213	*a*.269	29.137
	Feb.	17	3.3	17.40	21.18	82	1.48	.93	10.75	68	*b*2.92	3.90	11.2	*a*1.320	*a*.324	*a*29.198
	March.	17	3.9	15.93	30.10	80	1.82	1.14	10.54	59	*b*2.89	3.63	10.1	*a*1.339	*a*.248	29.126
	Jan.	16	3.6	13.65	18.72	85	1.32	.83	10.85	80	*b*2.87	3.89	10.5	*a*1.013	*a*.270	29.188
	April.	15	3.9	*a*20.11	*a*46.04	*b*76	3.11	1.94	9.74	53	*b*2.89	*a*3.26	*b*8.7	*a*1.103	.166	*a*29.230
	Dec.	14	3.7	15.44	20.44	82	1.36	.85	10.83	68	3.51	3.60	10.3	*a*1 108	*a*.220	*a*29.262

*, †, ‡, §, ‖, ¶, **. See foot-notes with these marks in Exhibit X., page 144.
a. An exception to Proposition 1, relating to Measles and Whooping-cough, on page 158.
b. An exception to Proposition 2, relating to Measles and Whooping-cough, on page 158.

EXHIBIT XXIV.—*Summary Relative to Propositions contained in Exhibits X, XII, XIV, XV, XVI, etc., (pages 144–152) concerning Relations, by Months in 1886, between Greater or Less than usual Prevalence of Diseases named, and certain given coincident Climatic Conditions.*

Diseases.	Months (inclusive) in which Diseases named were More than Usually Prevalent in 1886.	Months (inclusive) in which Diseases named were Less than Usually Prevalent in 1886.	For the 12 Months of the Year 1886. Number of Months in which Propositions Hold True.*										
			That in Months when Diseases named were more than Usually Prevalent the Conditions named below were Greater than Usual, and in Months when less than Usually Prevalent these Conditions were Less than Usual.									That in Months when Diseases named were more than Usually Prevalent the Conditions named below were Lower than Usual, and in Mos. when the Diseases were Less than Usually Prevalent these Conditions were Higher than Usual.	
			For Av. Daily Range of Temp.	Relative Humidity.	Av. Per Cent of Cloudiness.	Ozone. Day.	Ozone. Night.	Velocity of Wind.	Atmospheric Pressure. Range. Monthly.	Atmospheric Pressure. Range. Av. Daily.	Atmospheric Pressure. Average Daily.	Av. Temp.	Absolute Humidity.
Bronchitis	Jan. to May, Nov., Dec.	June to Oct.	2	8	10	5	9	10	10	9	6	10	11
Pneumonia	Jan. to May, Dec.	June to Nov.	3	9	9	4	8	9	9	8	7	9	10
Memb. Croup	Jan., Feb., Oct. to Dec.	March to Sept.	2	8	10	9	11	10	10	11	8	10	9
Diphtheria	Jan., Feb., Oct. to Dec.	March to Sept.	2	8	10	9	11	10	10	11	8	10	9
Tonsilitis	Jan. to April, Nov., Dec.	May to Oct.	1	9	11	6	10	11	11	10	7	11	12
Influenza	Jan. to April, Nov., Dec.	May to Oct.	1	9	11	6	10	11	11	10	7	11	12
Scarlatina	Jan. to June. Oct., Dec.	July to Sept., Nov.	5	7	7	4	8	7	9	8	7	7	8
Rheumatism	Feb. to June, Nov., Dec.	Jan., July to Oct.	4	6	8	5	7	8	8	7	6	8	9
Neuralgia	Jan. to May, Dec.	June to Nov.	3	9	9	4	8	9	9	8	7	9	10
Consumption	Jan. to June	July to Dec.	5	7	7	4	6	7	6	6	5	7	8

* The figures in each of these 11 columns show for how many months out of the twelve months in 1886 the proposition named over the column holds true; thus, concerning bronchitis, the proposition relative to Average Daily range of Temperature held true in only two months out of the twelve; that relative to Average Temperature, in ten out of twelve, etc.

EXHIBIT XXV.—*Summary Relative to Propositions contained in Exhibits XIX, XXI, etc. (pages 159, 161, etc.), concerning Relations, by Months in 1886, between Greater or Less than Usual Prevalence of Diseases named, and certain given coincident Climatic Conditions.*

Diseases.	Months (inclusive) in which Diseases named were More than Usually Prevalent in 1886.	Months (inclusive) in which Diseases named were Less than Usually Prevalent in 1886.	For the 12 Months of the Year 1886. Number of Months in which Propositions Hold True.*										
			That in Months when Diseases named were More Prevalent than Usual the Conditions named below were Higher than Usual, and in Months when the Diseases were less Prevalent than Usual these Conditions were Lower than Usual.						That in Months when Diseases named were More Prevalent than Usual the Conditions named below were Less than Usual, and in Months when the Diseases were Less Prevalent than Usual these Conditions were Greater than Usual.				
			Av. Daily Range of Temp.	Av. Temperature.	Absolute Humidity.	Atmospheric Pressure. Range. Monthly.	Atmospheric Pressure. Range. Av. Daily.	Atmospheric Pressure. Range. Average Daily.	Relative Humidity.	Av. Per Cent of Cloudiness.	Ozone. Day.	Ozone. Night.	Velocity of Wind.
Diarrhea	July to Oct.	Jan. to June. Nov., Dec.	9	9	10	3	4	7	7	9	4	8	9
Cholera Inf.	July to Oct.	Jan. to June. Nov., Dec.	9	9	10	3	4	7	7	9	4	8	9
Intermittent Fev.	April to Oct.	Jan. to March. Nov., Dec.	12	12	11	2	1	6	10	12	7	11	12
Remittent Fever	March to Sept., Nov.	Jan., Feb., Oct., Dec.	9	9	8	3	2	3	9	9	8	10	9
Typhoid Fever	Aug. to Dec.	Jan. to July.	6	6	7	6	7	8	6	6	1	5	6
Typho-mal. Fev.	Aug. to Nov.	Jan. to July. Dec.	7	7	8	5	6	7	7	8	2	6	7
Measles	March, May, June, Dec.	Jan., Feb., Apr., July to Nov.	5	5	6	5	6	5	5	5	6	6	5
Whooping-cough	May to Sept.	Jan. to April, Oct. to Dec.	10	10	11	0	1	4	8	11	7	11	10
Av. Disease	Jan. to May, Aug., Sept.	June, July, Oct. to Dec.	6	6	5	6	5	6	4	6	9	7	5

* The figures in each of these 11 columns show for how many months out of the twelve months in 1886 the proposition named over the column holds true; thus, concerning diarrhea, the proposition relative to Average Daily Range of Temperature held true in nine months out of the twelve; that relative to Absolute Humidity ten months out of twelve, etc.

TOTAL SICKNESS—AVERAGE DISEASE.

"Average disease" is an average of the tabulated diseases reported present on all the cards received and compiled at this office during the year. It is probably equivalent to the actual sickness from all diseases printed on the report cards, and probably represents very nearly the average sickness from all the diseases in the State. A sample of the report cards on which diseases are reported to this office is found on page 107. Twenty-seven diseases are printed on the cards. In 1886 there were 5,583 of these card reports received. On some of the cards only one or two diseases were reported present; on others twenty or more were reported present. Had each disease (printed on this card, and only the twenty-seven thus named) been reported present on every card received at this office, there would have been 150,741 reports of diseases present. (This is the product of 5,583 reports received multiplied by 27, the number of diseases printed on the cards, or 100 per cent of the possible disease reports.) There were actually present on the cards received at this office only 38,640 disease-reports which 38,640 ÷ 150,741 of the possible disease-reports that might have been present, is 26 per cent. This 26 per cent represents the actual sickness in the State from the tabulated diseases reported present, or in other words the sickness from "average disease." (See Diagram 5, page 156.)

Exhibit XXVI. serves to indicate the probable actual sickness in the State from the tabulated diseases in each year from 1877 to 1886. It compares the sickness in 1886 by months with the sickness by months in each of the ten years 1877 to 1886.

It will be seen by this exhibit that the sickness reported in 1886 was, for the year, and for each month of the year, less than the average reported for the ten years 1877–1886.

EXHIBIT XXVI.—SICKNESS FROM AVERAGE DISEASE, 1877-86.—*By Year and Months for each of the Ten Years 1877-86. Stating on an Average for such of the 27 diseases tabulated as were reported present, what per cent of the Weekly Reports received stated presence of the Diseases, and comparing the Average Per Cents for Months in 1886 with the Averages for corresponding Months in those Years.*

Years, etc.	Annual Av.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average 10 Years, 1877-86	30	30	31	31	30	28	27	29	32	33	31	30	29
1877	28	27	28	26	24	24	23	26	29	31	30	30	30
1878	30	30	30	31	29	28	26	28	32	35	34	30	32
1879	33	35	36	36	35	30	30	32	37	36	34	34	33
1880	32	32	32	32	31	30	31	34	36	35	32	30	31
1881	33	34	34	32	35	31	30	34	37	36	35	32	31
1882	30	31	30	30	30	29	28	28	30	34	32	31	29
1883	30	30	31	33	33	31	29	29	32	32	29	29	28
1884	29	28	29	30	28	28	29	31	34	34	33	30	29
1885	26	29	29	30	28	25	24	26	27	27	26	26	26
1886 (Diagram, page 1.)	26	26	26	28	27	26	23	26	27	28	25	25	25
In 1886 **Greater** than Av. 1877-86													
In 1886 **Less** than Av. 1877-86	4	4	5	3	3	2	4	3	5	5	6	5	4

RELATIONS OF TOTAL AMOUNT OF SICKNESS TO METEOROLOGICAL CONDITIONS.

PROPOSITION 1.—That in months when **more** than the average per cent of weekly reports stated the presence of such of the 27 diseases tabulated (in tables on pages 94–111) as were reported present, the average daily range of temperature, the average daily temperature, the absolute humidity of the atmosphere, the monthly and the average daily range of the barometer, and the average daily pressure of the atmosphere, were **greater** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of said diseases those conditions were **less** than the average for the year. In Exhibit XXVII., below, the letter *a* marks exceptions to this proposition for the year 1886.

PROPOSITION 2.—That in months when **more** than the average per cent of weekly reports stated the presence of such of the twenty-seven diseases tabulated as were reported present, the relative humidity of the atmosphere, the average per cent of cloudiness, the ozone, and the average velocity of the wind were **less** than the average for the year; and in months when **less** than the average per cent of reports stated the presence of said diseases those conditions were **greater** than the average for the year. In Exhibit XXVII., below, the letter *b* makes exceptions to this proposition for the year 1886.

What per cent of the weekly reports received in 1886 (on an average for such of the tabulated diseases as were reported present) stated presence of the diseases is graphically represented by months in Diagram 5, page 156.

EXHIBIT XXVII.—AVERAGE DISEASE.—*Stating for the Year and for each Month of the Year 1886, What Per Cent of the Weekly Reports of Sickness on an Average for such of the 27 Tabulated Diseases as were Reported Present, Stated Presence of the Diseases, and what were the Meteorological Conditions Observed at Stations in Michigan.**

AVERAGE DISEASE.				Temperature, F.		Humidity of Air.§ Av. of 3 Daily Observations.		Vapor Inhaled and Exhaled from Air-Passages by one Person in 24 Hours. Troy Ounces.		Average Per Cent of Cloudiness.	Ozone—Relative Scale of 10°.		Average Velocity of Wind, Miles Per Hour, by Anemometer.	Atmospheric Pressure, Inches. Reduced to 32° F.		
Months in Order of Greatest Per Cent of Weekly Reports Stating Presence of.		Per Cent of Weekly Reports Stating Presence of.†	Average Order of Prevalence Where Present.‡	Average Daily Range, by Registering Thermometers.	Average of 3 Daily Observations.	Relative Per Cent of Saturation.	Absolute—Grains of Vapor in a Cubic Foot of Air.	Inhaled.‖	Exhaled, in Excess of that Inhaled.¶		Day Observation, 7 A. M. to 2 P. M.	Night Observation, 9 P. M. to 7 A. M.		Range. Monthly and for Year.	Range. Av. Daily, by 3 Daily Observations.**	Average Pressure.
More than Av. Per Cent of Average Disease.	March.	28	3.9	a15.98	a30.10	b80	a1.82	1.14	10.54	b59	2.89	b3.63	b10.1	1.339	.248	a29.126
	Sept.	28	3.8	18.85	61.15	b78	4.94	3.09	8.59	52	2.94	3.45	b9.0	a.717	a.187	29.222
	April.	27	3.7	20.11	46.04	76	a3.11	1.94	9.74	53	2.89	3.26	8.7	1.103	a.166	29.230
	Aug.	27	3.8	19.77	67.36	75	5.75	3.59	8.09	43	b3.04	3.28	7.4	a.597	a.142	a29.166
	Feb.	26	3.7	a17.40	a21.18	b82	a1.48	.93	10.75	b68	2.92	b3.90	b11.2	1.320	.324	29.198
	May.	26	3.8	21.87	54.69	72	3.82	2.39	9.29	48	2.91	3.27	8.4	a.728	a.157	a29.128
	Jan.	26	3.8	a13.65	a18 72	b85	a1.32	.83	10.85	b80	2.87	b3.89	b10.5	1.013	.270	a29.188
Average		26	3.7	18.53	44.82	77	3.32	2.08	9.60	55	2.99	3.46	9.2	.941	.205	29.192
Less than Av. Pr. Ct. of Average Disease.	July.	25	3.5	a22.94	a68.68	b71	a5.59	3.49	8.19	b36	b2.51	b2.88	b7.0	.506	.112	29.159
	Oct.	25	3.6	a19.31	a51 84	b75	a3.64	2.28	9.40	b45	3,14	3.53	b8.8	a1.406	a.229	a29.331
	Dec.	25	3.8	15.44	20.44	82	1.36	.85	10.83	68	3.54	3.60	10.3	a1.108	a.220	a29.262
	Nov.	25	3.7	15.11	34.32	b76	2.02	1.26	10.42	63	3.30	3.59	12.0	a1.213	a.269	29.137
	June.	23	3.5	a22.02	a63.31	b72	a4.98	3.11	8.57	b42	b2.89	b3.28	b7.3	.600	.131	29.161

*, †, ‡, ‖, §, ¶, **. See foot-notes with these marks in Exhibit X., on page 144.
a. An exception to Proposition 1, relating to Average Disease, on page 168.
b. An exception to Proposition 2, relating to Average Disease, on page 168.

Exhibit XXVII., continued for a series of years, should show what meteorological conditions are on the whole most conducive to health in Michigan, and what are most to be guarded against by residents in Michigan.

THE SEWERAGE OF THE CITY OF MARQUETTE.

CORRESPONDENCE, AND REPORT OF EXAMINATION BY THE SECRETARY OF THE STATE BOARD OF HEALTH.

The following correspondence and report of examination is self-explanatory, and records some of the action taken with the view to the improvement of the sanitary conditions in the city of Marquette.

LETTER FROM A. KLINE THIELL, M.D., HEALTH OFFICER OF MARQUETTE.

MY DEAR DOCTOR BAKER:—At a meeting of the "Sewerage Commission" (the Hon. Horatio Seymour, chairman) held on Saturday the 6th of November, 1886, it was resolved, "That our Health Officer be requested to correspond with the Secretary of the State Board of Health, with a view to making some arrangement by which we can have the benefit of his advice in our labor, to this end he is to be brought here, if possible, to personally overlook the ground."

The causes leading up to the above resolution were as follows: Some time ago the City Council appointed a "Sewerage Commission," composed of a number of our leading business men, among them two civil engineers, to devise a plan of thorough and complete sewerage for the city, Such plan has been made, but when it came to the question of an outlet, a difficulty presented itself. The commission are in favor of such outlet being inside our breakwater, in our harbor, in fact, but one of our leading physicians, with a very respectable following, opposes this on the ground that there is already enough refuse matter in the bay, that any more will render it dangerous to public health, while, on the other hand, others, myself among the number, hold that to empty the pipes at the only other available point, would be to run great risk of a contaminated water-supply.

This is the point on which the commission desires your advice. Of course, maps, profiles, etc., with a fuller and more complete statement of the contested point might be sent you, but it seems to us better, considering the fact that it is a question of such paramount, such vital importance, that you should personally examine the ground.

There is also one other point. Our community are now suffering from an epidemic of enteric fever, there being from fifteen to twenty cases in the city at the present time: as some of these are users of the lake water as supplied by the works, it is charged by some that the water-supply is already contaminated with sewage material.

To this I cannot agree, but we would like to have the question settled at once by you, either by an analysis or in any other way that in your judgment may seem best.

So if you will let me know at once as to your coming, whether possible or not, also as to question of expenses, fee, etc., you will greatly oblige,

Yours very respectfully,

A. KLINE THIELL.

Marquette, Michigan, 7th November, 1886.

REPORT OF HENRY B. BAKER, M. D., ON PLAN FOR SEWERAGE OF MARQUETTE.

To the Board of Sewer Commissioners, Marquette, Mich.:

GENTLEMEN:—As a result of the examination and study which I have been enabled to make of the conditions existing in your city and its surroundings, I respectfully submit, from my standpoint, the following considerations:—

The city is beautifully situated for natural surface drainage, a large part of which drainage, however, must go into the harbor; and from a large part of the city the sewage (unless pumping works be established) must also go into the harbor. This will forever make it impracticable for the city to obtain its water-supply from any point south of the city, and yet the pure lake water is desirable as a water-supply, and will undoubtedly be obtained from the lake north or east of the city. It seems certain that the currents in the lake near the shore are not always the same, because of prevailing winds from different directions at different times. Sewage is poured into the harbor, or west and southwest of the present water intake; if it was poured into the lake northwest of the intake, it seems to me that the chances of contaminating the water at the intake would be doubled. Therefore it would seem to be best not to let sewage go into the lake on both sides of the water-supply intake, especially as the distance in either direction is not great, so long as the intake remains where it now is. If at some future time it is practicable to take the water-supply from the lake at a point farther north, as, for instance, near the northern terminus of Pine street, then it would still seem to be best to have the outfalls of the sewers as far as possible from the water intake; and for that reason the outfalls should be south of light-house point. In order that they shall be as distant as possible from the water intake, and because the continuous pouring of sewage into a stagnant place near the residence streets should be avoided, it seems to me to be best to have all sewer outlets as far south as possible; and I recommend that it be ascertained whether it is possible to have an intercepting sewer along Lake street from near the water works to Whetstone brook or farther, this sewer to intercept all sewage which otherwise would go into the harbor, and to deliver it at the farthest possible distance from the source of the water-supply and from the most stagnant part of the harbor. If this cannot be done while all sewers carry storm and surface water, because the intercepting sewer would then be too great, it may still be practicable by permitting storm and surface water, such as the present contents of the Spring street sewer, to empty directly into the harbor, putting in down Spring street or other such place a similar conduit to convey the actual sewage, and acting on a similar principle wherever practicable.

If it is found impracticable to have the intercepting sewer along Lake street or the harbor shore, large enough to carry all sewage which otherwise would naturally go directly into the harbor, I would still hold to the same principle of delivering all sewage as far as possible to the south (and to the southeast from Whetstone brook) and would consider the plan of having a sewer down Front street as far southward as practicable.

I believe it is your design and it seems to me important that surveys of the entire city be taken with the view to the establishment of a general plan of sewerage; and that this be done before any further work is done on any sewer. In laying out the general plan, one of the most important governing principles should be to have the outfalls of all the sewers as far as possible from the water intake. By holding most of the sewers well up on high ground until they reach as far to the south as practicable, it would seem to be possible to leave so little sewage to be conveyed in the intercepting sewer along Lake street as that it would be practicable to have such a sewer, and to avoid pouring sewage into the most stagnant part of the harbor, and to let it enter where it would be likely to be more quickly diluted and to be washed outside the breakwater in a more dilute form than it would be through the interstices

of the breakwater (as it is now constructed) if tons of sewage should be emptied into the harbor behind the breakwater.

Trusting that, whether or not my advice is taken, Marquette will soon be a well-sewered city, abundantly supplied with pure water, that such diseases as typhoid fever may be in great part prevented, and that the city may continue to be a beautiful and healthful summer resort, I remain,

Very respectfully,

Michigan State Board of Health, HENRY B. BAKER,
Office of the Secretary, Lansing, Mich., Nov. 30, 1886. *Secretary.*

LETTER FROM HON. HORATIO SEYMOUR.

MARQUETTE, December 3, 1886.

Dr. Henry B. Baker, Sec'y of the Mich. State Board of Health, Lansing, Mich.:

DEAR SIR:—Your letter containing the report on the Marquette sewerage, and a paper on the "Death Rate in Cities," by E. F. Smith, has been received, for which please accept the thanks of the Commissioners. We are under many obligations to you for your visit here, and the assistance you have rendered in our work, and we would be glad to compensate you for your services. Please write me on this subject. Very respectfully yours,

HORATIO SEYMOUR,
Chairman Board of Sewer Commissioners, Marquette, Mich.

LETTER FROM M. L. HEWITT, M. D.

MARQUETTE, MICH., Dec. 26, 1886.

Henry B. Baker, M. D.,

DEAR SIR:—Your report to the Board of Sewer Commissioners, Marquette, Mich., is very satisfactory to me. You have comprehended the whole matter. I am obliged to you for the pamphlets you have sent me, I shall read them with interest. I hope that I may see you here again.

Very truly yours,

M. L. HEWITT.

THE TYPHOID FEVER IN MARQUETTE.

In company with Dr. Thiell, the health officer of the city, I visited houses in which were persons sick with typhoid fever, and examined other premises in which other cases had occurred. As stated by Dr. Thiell in his letter which accompanies this report, some of these persons had used the city water, while others did not habitually use that water. In one case the water was obtained from a well, the surroundings of which—especially the location and direction of the privy vault—led to the belief that the water was probably contaminated by leachings which might contain the cause of the typhoid fever. In my opinion an analysis of the well water would not have added materially to the value of the evidence of the inspection, which I considered sufficient of itself to forbid the use of the water except after boiling, and this opinion would still have been held, even if on analysis of the water no dangerous amount of organic matter had been found.

The water-works building was visited, and the intake and surroundings carefully studied. There had recently been a severe storm which had unusually roiled the water, and samples of water pumped about that time had been preserved in bottles, and showed that for a day or two, at least, the water contained organic matter which was plainly visible by the unaided eye, but which seemed to be mainly sawdust washed up by the storm. However, the sewage in the most land-locked portion of the harbor was apparently not entirely prevented from reaching the intake, because the government pier or

breakwater was not water-tight, but the water surged through it in whichever direction the wind caused the current to move, and this might be directly from the contaminated harbor toward the intake at the water-works. The prevailing opinion seemed to be that something must be done to improve the chances of safety in the use of the water—either the intake pipe be extended farther out from the present location, or the water-works moved to a location farther north.

In the time at my disposal, and with the difficulty of learning all the facts concerning the habits and surroundings of those who had typhoid fever, I was unable to trace to their exact cause all the cases of typhoid fever. My invitation was from the board of sewer commissioners, and the most of my efforts were to aid them in their work, especially as we know that a good general water-supply and good sewerage may safely be relied upon to prevent typhoid fever.

Respectfully submitted,

HENRY B. BAKER.

PRESIDENT'S ANNUAL ADDRESS.

BY HON. JOHN AVERY, M. D., PRESIDENT OF THE MICHIGAN STATE BOARD OF HEALTH.

[Read at the regular meeting of the State Board of Health, Jan. 11, 1887.]

Gentlemen of the Board:

It would seem appropriate that we should pause at the beginning of the new year to examine the work done in the past, and to forecast, as far as possible, the duties of the Board in the future.

It is certain that the first and highest duty of the State is the protection of the health and lives of its citizens. If health is luxury to the rich, it is the poor man's capital; and the wages of each day's work is the interest that capital pays its owner. The loss of a day's work is a loss of interest on invested capital. Any impairment of health is a loss of capital itself. Sickness not only impairs ability to labor, but it entails expenses, and thus both stops interest and encroaches upon capital. When this impairment of health is the result of a preventable cause, it is evidence that a wrong has been committed by some one.

To prevent these wrongs so far as possible, and to protect the health and lives of its citizens, the State has enacted public health laws, created a State Board of Health, and a local board of health in every municipality in the State. The duties of these boards are clearly defined in the laws creating them. Those of the State Board are supervisory and advisory. It has the "general supervision of the interests of the health and life of the citizens of the State." It has now been in existence thirteen years, a sufficient length of time to warrant a brief review of the work it has done.

Has it steadily approached the object for which it was created? Has it faithfully endeavored to perform its duties? Has it met the expectations of its friends and won the confidence of the people of the State?

Perhaps I can not better summarize the work of the Board in the past than by quoting from an article read by me before the sanitary convention, held in Lansing last March: "The State Board of Health has earnestly and honestly endeavored to carry out every provision of the law creating it. It has each year kept its expenditures within the amount appropriated for its use, and covered back into the treasury an unexpended balance. It has prepared, printed, and circulated among local boards of health, health officers, and the people, over 500,000 copies of monographs on different sub-

jects relating to public health; it has collected records of sickness and deaths in different parts of the State and given the results back to the whole people; it has inquired into the causes of local epidemics and advised and warned such communities of their danger. It has investigated special causes of sickness, such as poisonous cheese, diseased meats, adulterated foods, and polluted water-supplies. The members of the Board have visited various places in the State where nuisances have been reported to them by aggrieved citizens, and advised as to the remedy in such cases. They have visited, at the request of the Board of Corrections and Charities, poor-houses and jails in different counties of the State, called attention to their defects and pointed out how they might be improved. They have visited the prisons and other State institutions at the request of their officers or boards of control, to advise how their condition could be bettered; and their advice has generally been kindly and courteously received, and often acted upon to the improvement of such institutions. They have examined plans of public buildings about to be erected, and suggested alterations as to heating, ventilation, sewerage, drainage, plumbing, and lighting, and safety in case of fire, and their suggestions have been kindly and thankfully received and acted upon by architects and builders. And the result of these inspections of the plans of public buildings is, not only that the State has buildings better adapted to the uses for which they are designed, but more attention is being paid to these details in building public halls, school-houses, churches and private residences, and in this way the comfort, safety and health of the people are better cared for. They are in direct and frequent communication with every city, village and township in the State through their local boards of health and health officers. They act as a sort of central signal station to which signals of alarm and danger are sent from every part of the State and from which warning is sent to the endangered and advice to the afflicted."

The Board has maintained pleasant and profitable relations with neighboring State Boards of Health, and with the National Board of Health, and its work has been approved and commended by both.

There can be no question but that the practical exemption of the people of this State from small-pox during the prevalence of an epidemic in a neighboring province, that paralyzed business and claimed more than four thousand victims, in 1885, was due to the efficient immigrant inspection service inaugurated by the Michigan State Board of Health, and afterwards continued by the national health authorities.

There have been held under the auspices of the Board, sixteen sanitary conventions in as many different localities in the State.

These conventions have generally been well attended by local health officers, in their immediate vicinity, and by the public generally, with the effect of bringing the local health officers and the State Board into closer relations with each other, and of creating a more general interest in all matters pertaining to the public health. The papers read at these conventions and the discussions elicited have been given to the people.

While it is true there are at the present time frequent outbreaks of communicable diseases, particularly of scarlet fever and diphtheria, it is also true that these outbreaks are generally confined to the initial cases, and owing to the better information of the people and more efficient action of local boards of health, these diseases are not allowed to spread as in former years.

This summary of work accomplished is also a forecast of the work to be continued by the Board.

Continue the education of the people by means of sanitary conventions and the circulation of printed matter upon all subjects pertaining to public health work upon which the public need to be informed.

Inaugurate and carry forward a vigorous and uncompromising campaign against the ever present nuisance of the privy vault and cesspool.

Devise some practical method for the disposal of excreta and kitchen waste in unsewered cities, villages and the rural districts, that the water supply may not be polluted in these localities.

If possible, inaugurate a system of house-to-house inspection, in order that each municipality may be informed of the sources of danger in its midst.

Would it not be in the interest of public health for the Board to inquire into the practical value of teaching the elements of hygiene in our common and graded schools?

Would it not be of value to the people of the State, and in the interest of public health, for the Board to make suggestions in regard to the construction, heating and ventilation of common country school-houses, and perhaps to furnish a few general plans for the same?

And now, gentlemen, fully impressed with the importance of the work accomplished by the Board in the past, and with its value to the people of the State, and with a firm belief that its usefulness will increase with each year's added experience, it remains for me to congratulate the Board that it has been its good fortune to have been at all times so ably represented by a competent and efficient secretary, and to thank each individual member for the uniform courtesy I have received from them during the time I have been connected with the Board.

THE CHEMISTRY OF TYROTOXICON:

ITS ACTION UPON LOWER ANIMALS; AND ITS RELATION TO THE SUMMER DIARRHEAS OF INFANCY.

BY VICTOR C. VAUGHAN, M.D., PH. D., PROFESSOR OF PHYSIOLOGICAL CHEMISTRY IN THE UNIVERSITY OF MICHIGAN, AND MEMBER OF THE STATE BOARD OF HEALTH.

[Presented at the Quarterly Meeting of the Board, April 13, 1887.]

Since making my last report to this Board on the investigations concerning the nature of tyrotoxicon (Report of Proceedings of the Michigan State Board of Health, October, 1886), I have continued my work, aided greatly by Messrs. F. G. Novy and E. V. Riker. We soon ascertained that if some butyric acid ferment be prepared as is ordinarily done in the preparation of butyric acid, and some of this be added to normal milk, and the whole be kept in closely stoppered bottles for eight or ten days, the poison will be developed in the milk in considerable quantity. The milk should be filtered, the filtrate neutralized with sodium carbonate, and then extracted with ether.

Having a strong solution of the poison in absolute alcohol, which had been obtained from milk inoculated as stated above, we added to it some platinum chloride and began to evaporate on the water-bath. As soon as the alcohol evaporated, the residue exploded with great violence. The vessel, a glass evaporating dish, was broken into fine fragments, and these were scattered over the room; while the gas-light of burner under the water-bath was extinguished. The experiment was repeated a number of times with like results. From some of this alcoholic solution, the platinum was removed with hydrogen sulphide gas; but the filtrate was then found to have lost its explosive property. This reminded us that diazobenzol compounds form with platinum chloride a highly explosive compound, and that these are also decomposed by hydrogen sulphide. Some diazobenzol nitrate was prepared according to the method of Griess,* and comparisons made between this and tyrotoxicon.

With equal parts of sulphuric acid and carbolic acid the prepared diazobenzol nitrate gave a green coloration; while with the same reagents,

*Annalen der Chemie und Pharmacie, B. 137, S. 39 et seq.

tyrotoxicon gave a color which varied from a yellow to an orange-red. But the diazobenzol nitrate dissolved in the whey of normal milk, and extracted with ether or in the presence of other proteids, gave the same shades of color as the tyrotoxicon did, and, the potassium compound of tyrotoxicon, prepared by the method to be given later, produced the same shade of green as did the artificial diazobenzol. This color test may be used as a preliminary test in examining milk for tyrotoxicon. It is best carried out as follows: place on a clean porcelain surface two or three drops each of pure sulphuric acid and pure carbolic acid. This mixture should remain colorless or nearly so. Then add a few drops of the aqueous solution of the residue left after the spontaneous evaporation of the ether. If tyrotoxicon be present, a yellow to an orange-red color will be produced. This test is to be regarded as only a preliminary one; for it may be due to the presence of a nitrate or nitrite.* The tyrotoxicon must be purified according to a method to be given further on, before the absence of nitrate or nitrite can be positively demonstrated.

In the filtrate from milk which is rich in tyrotoxicon, after neutralization with sodium carbonate, filtration and acidifying with hydrochloric acid, gold chloride produces a precipitate, which is insoluble in water, but soluble in hot alcohol, from which it separates on cooling in golden plates. Diazobenzol compounds give with gold chloride a precipitate having all these properties. In both cases the gold compound is decomposed by frequent treatment with hot alcohol, and this fact prevented any satisfactory ultimate analysis of this salt. It should be remarked here that from some samples of milk this gold salt is obtained much more easily than from others, and the difference is dependent not so much upon the amount of tyrotoxicon present, as upon the condition of the other organic matter present. It is best obtained from samples which have stood in well stoppered bottles for a month or longer.

Tyrotoxicon obtained from milk was treated according to the method recommended by Griess,† for the preparation of diazobenzol-potassium hydrate and the per cent of potassium in the compound obtained was determined. The filtrate from the milk which had been inoculated with the ferment and kept in a stoppered bottle in a warm room for ten days was neutralized with sodium carbonate, agitated with an equal volume of absolute ether, allowed to stand in a stoppered flask for 24 hours, the ether removed and allowed to evaporate from an open dish. The aqueous residue was acidified with nitric acid, then treated with an equal volume of a saturated solution of potassium hydrate and the whole concentrated on the water-bath. On being heated the mixture became yellowish-brown and emitted a peculiar aromatic odor. Both the color and odor corresponded exactly with the color and odor produced by carrying some of the artificial diazobenzol through a comparative test. On cooling, the mass crystallized, the resulting compound appearing in the test with the tyrotoxicon and in the comparative test also, in beautiful, six-sided plates, along with the prisms of potassium nitrate. The crystalline mass obtained from the tyrotoxicon was treated with absolute alcohol, filtered, the filtrate evaporated on the water bath, the residue dissolved in absolute alcohol, from which it was precipitated in colorless crystals on the addition of ether. The precipitate was collected, washed with ether, dried, and the per cent of potassium estimated as potassium sul-

*Nitrates and nitrites really give a much darker coloration than that produced with diazobenzol, and one who has made frequent observations of this test will not be likely to mistake one for the other.

†Annalen der Chemie und Pharmacie, B. 137, S. 54.

phate. .2045 gram of the substance yielded .109 gram of potassium sulphate. Per cent of potassium: calculated in, $\overset{C}{6}\overset{H}{5}\overset{N}{2}\overset{O}{}\overset{K}{}$ 24.42; found, 23.92. This analysis establishes the identity of tyrotoxicon and diazobenzol. Chemists will now appreciate the great difficulty that has been experienced in isolating the active agent of poisonous cheese. The readiness with which diazobenzol decomposes is well known. When warmed with water it breaks up into carbolic acid and nitrogen. Hydrogen sulphide decomposes it; therefore, all attempts to obtain the poison by precipitating it with some base, such as mercury or lead, and then removing the base with hydrogen sulphide, have failed. Moreover, diazobenzol is only a transition product of putrefaction. I have frequently found that leaving milk rich in the poison in an open beaker for 24 hours would be sufficient to destroy the whole of the poison.

We know nothing positively concerning the acid with which diazobenzol is combined in the milk or cheese. We prepared some diazobenzol butyrate, $\overset{C}{6}\overset{H}{5}\overset{N}{2}\overset{C}{4}\overset{H}{7}\overset{O}{2}$, and ascertained that the crystals of this compound correspond with those of tyrotoxicon, and decompose in moist air with the same rapidity.

This is the first time diazobenzol has been found as a product of putrefaction, and it is possible that many of its allied compounds may be formed in the same way.

The following experiments will show that the effects of tyrotoxicon and diazobenzol upon the lower animals are identical:—

Experiment 1. From one half gallon of some milk, which had stood in a tightly stoppered bottle for three months, there was obtained quite a concentrated aqueous solution of the poison after the spontaneous evaporation of the ether. Ten drops of this placed in the mouth of a small dog three weeks old caused within a few minutes frothing at the mouth, retching, the vomiting of frothy fluid, rapid breathing, muscular spasm over the abdomen, and after some time watery stools. The next day the dog seemed to have recovered partially; but was unable to retain any food. This condition continuing for two days, the animal was killed with chloroform. No examination of the stomach was made.

Experiment 2. Tyrotoxicon obtained from poisonous ice cream was given to a cat. Within ten minutes the cat began to retch and soon it vomited. The retching and vomiting continued for two hours, during which time the animal was under observation, and the next morning it was observed that the cat had passed several watery stools. After this, although the cat could walk about the room, it was unable to retain any food. Several times it was seen to lap a little milk, but on doing so it would immediately begin to retch and vomit. This condition continuing, after three days the animal was placed under ether, and its abdominal organs examined. We certainly expected to find marked inflammation of the stomach; but we really did find the stomach and small intestines filled with a frothy, serous fluid, such as had formed the vomited matter, and the mucous membrane very white and soft. There was not the slightest redness anywhere along the alimentary canal.

Experiment 3. Some tyrotoxicon obtained from milk which had been inoculated with poisonous cream and allowed to stand for 48 hours was administered to a large, old cat. It soon produced retching, but no vomiting or diarrhea. The amount of the poison administered in this case was small.

Experiment 4. Some tyrotoxicon from milk was given to a young, but

full grown cat. Within 15 minutes there was marked and evidently painful retching, and within half an hour, vomiting accompanied by rapid breathing. Later there were several stools, the first two of which contained fecal matter; but the subsequent ones were rice-water like and wholly free from fecal odor. After two days some more of the poison was given, and the vomiting and diarrhea again induced. The animal was then anesthetized, and examination of the stomach and intestine showed the mucous membrane blanched as was found in experiment 2.

We have the records of a number of other experiments with tyrotoxicon on the lower animals; but as the symptoms induced in all were substantially the same, it is unnecessary to note them here. We will now give the effects observed in the lower animals after the use of the prepared diazobenzol:

Experiment 5.—Gave to a large, old cat, 100 milligrams of diazobenzol butyrate. Immediately the animal began to purge. Then she lay upon the floor breathing rapidly and retching severely, for two hours, when she died. The retching was most violent, but vomiting seemed impossible. Post mortem examination showed the lungs greatly congested, but the mucous membrane of the stomach and intestine was not reddened. The stomach contained some food.

I suppose that the congestion of the lungs was due to the violent retching.

Experiment 6.—To a young but full grown Maltese cat we gave 100 milligrams of diazobenzol butyrate. With most violent retching, but without either vomiting or stool, the animal died within thirty minutes after the administration of the poison. The lungs were found acutely congested, and the stomach free from any redness. The circular fibres of the small intestine were tightly contracted.

Experiment 7.—Gave to a full grown cat 25 milligrams of diazobenzol butyrate. Within 10 minutes vomiting and purging were induced. The first stools contained fecal matter; but the subsequent ones were like rice-water and wholly free from fecal odor. After two days the cat was able to take food, then ten milligrams more of the poison was given, with the reproduction of the vomiting and purging. The animal then rapidly emaciated, and after a few days it was anesthetized and the mucous membrane of the stomach and intestine found blanched. The lungs were not congested.

Experiment 8.—10 milligrams of the poison produced profuse diarrhea, and continued vomiting in a cat.

Experiment 9.—75 milligrams produced vomiting and diarrhea, with congestion of the lungs, in a dog.

It seems unnecessary to detail any more of these experiments, as the identity of tyrotoxicon with diazobenzol is now established, not only by chemical analysis, but this proof is strengthened, if chemical analysis can be strengthened, by the action of the poison on the lower animals and by post-mortem appearance.

I think it highly probable that diazobenzol or some closely allied substance will be found in all those foods, which from putrefactive changes, produce nausea, vomiting and diarrhea. In some oysters which produced these symptoms, I have recently found tyrotoxicon.

Milk or other fluid to be tested for this poison should be kept in well stoppered bottles, for if the fluid be exposed to the air, the tyrotoxicon may decompose in a few hours. The filtrate from the milk or the filtered aqueous extract of cheese should be neutralized with sodium carbonate, then shaken

with half its volume of pure ether. Time should be given for the complete separation of the ether. Purified tyrotoxicon is insoluble in ether, and it probably owes its solubility in ether at this stage to the presence of impurities. After complete separation the ether should be removed with a pipette and allowed to evaporate spontaneously from an open dish. The residue from the ether may be dissolved in distilled water and again extracted with ether; but repeated extractions with ether are to be avoided, for as the tyrotoxicon becomes purified, it becomes less soluble in ether. To a drop of an aqueous solution of the ether residue apply the preliminary test with sulphuric and carbolic acids. To the remainder of the aqueous solution of the ether residue add an equal volume or a saturated solution of caustic potash, and evaporate the mixture on the water-bath. The double hydrate of potassium and diazobenzol will be formed if tyrotoxicon be present, and this may be recognized by its properties and reactions which have already been described.

The above mentioned experiments upon the cats and dogs, strengthen us in the belief that the development of this poison in milk is a frequent cause of cholera infantum and kindred affections. When we remember that these diseases are most prevalent among the poor classes of our large cities where fresh milk is almost unknown, we can readily understand their frequency. By such people milk is often not obtained until it has begun to sour, then it is kept at a high temperature and often in a most foul atmosphere, and we all know something of the readiness with which milk takes up bad odors. This milk is then eaten by the little ones who are weakened by poverty and everything that poverty means, insufficient food generally, and that of the poorest quality, insufficient clothing, insufficient and vitiated air. With these facts before us it is not surprising that in all our large cities thousands of children die annually from the summer diarrheas. Moreover, in our country places, how little attention is given to the food of children, we all know from actual observation. Cows stand and are milked in filthy barns and yards. The udders are generally, so far as my observation goes, not washed before the milking; the vessels for the milk are frequently found not as clean as they should be. Then there are the thousand of children that must draw their sustenance from bottles, the cleansing of which is in many families not properly attended to. Crusts of decomposing milk form around the neck of the bottle, in the tube and nipple, and lead to the rapid decomposition of the entire contents of the bottle. I think that one of the most important advantages to be secured to breast-fed children arises from the lessened danger of infection of the milk with germs which may produce poisonous ptomaines.

I would not claim that decomposed milk is the sole cause of the summer diarrheas of children, nor would I claim that tyrotoxicon is the only poison that may be developed in milk. It is only one of a large class of bodies which are produced by putrefaction, and many of these are cathartic in action.

But will this knowledge concerning the development of poisons in milk and other foods aid us in the prevention and treatment of these diseases?

Preventive measures will consist for the most part, in attention to the diet and especially to milk. I have drawn up the following rules concerning the care of milk:

1. The cows should be healthy, and the milk of any animal which seems indisposed should not be mixed with that from the perfectly healthy animals.

2. Cows must not be fed upon swill, or the refuse of breweries, or glucose factories, or any other fermented food.

3. Cows must not be allowed to drink stagnant water; but must have free access to pure, fresh water.

4. Cows must not be heated or worried before being milked.

5. The pastures must be free from noxious weeds, and the barn and yard must be kept clean.

6. The udders should be washed, if at all dirty, before milking.

7. The milk must be at once thoroughly cooled. This is best done by placing the milk can in a tank of cold spring water or ice-water. the water being of the same depth as the milk in the can. It would be well if the water in the tank could be kept flowing; indeed, this will be necessary unless ice-water is used. The tank should be thoroughly cleaned every day to prevent bad odors. The can should remain uncovered during the cooling, and the milk should be gently stirred. The temperature should be reduced to 60° F. within an hour. The can should remain in the cold water until ready for delivery.

8. In summer when ready for delivery the top should be placed on the can and a cloth wet in cold water should be spread over the can, or refrigerator cans may be used. At no season should the milk be frozen; but no buyer should receive milk which has a temperature higher than 65° F.

9. After the milk has been received by the consumer, it should be kept in a perfectly clean place, free from dust, at a temperature not exceeding 60° F. Milk should not be allowed to stand uncovered, even for a short time, in sleeping or living rooms. In many of the better houses in the country and village and occasionally in the cities, the drain from the refrigerator leads into a cesspool or kitchen-drain. This is highly dangerous; there should be no connection between the refrigerator and any receptacle of filth.

10. The only vesels in which milk should be kept are tin, glass, or porcelain. After using the vessel, it should be scalded and then, if possible, exposed to the air.

With the attention, demanded by these rules, given to milk, it will become more valuable as a food and the development of poisons in it before its introduction into the body will certainly be prevented.

But in the prevention of the summer diarrheas, attention to the food must not stop with its introduction into the body. The ferment which produces tyrotoxicon is widely distributed and it only awaits conditions suitable for its development. We do not know exactly what germ it is that produces this poison; but it is either the butyric acid ferment or some ferment which is frequently developed along with the bacillus butyricus; because I have found that if some butyric acid ferment be prepared according to the method usually followed in making butyric acid and milk be inoculated with this and allowed to stand at the temperature of the body for a few hours or at the ordinary temperature of the room for several days, the poison will appear. Moreover, as is well known the bacillus butyricus grows best in the absence of air, we have already seen that the exclusion of air favors the development of tyrotoxicon. We are aware of the fact that the butyric acid ferment frequently does develop in the stomach. Therefore, I think that the prevention of these diseases necessitates some attention to digestion. If the food lies in the stomach or intestine undigested, putrefactive changes will occur there.

During the hot months, children who are allowed to take food at will often drink large quantities of milk simply for the purpose of quenching thirst. Especially is this true when the parent forgets that a child would sometimes relish a drink of good water. I feel that this overloading the stomach with milk caused by thirst often is of no little detriment. It is hardly necessary to specify in regard to other ways in which attention should be given to the digestive organs of children. Those that partake of other foods with their milk should be allowed only the most wholesome articles, and these should be in perfect condition. Moreover, the depressing effects of extreme heat on the nervous system and its consequent injury to digestion should always be borne in mind.

Now we come to the discussion of the curative treatment of these diseases. The first thing to do is to stop the administration of milk in any form. The ferment is present in the alimentary canal, and giving the best of milk would simply be supplying the germ with material for the production of the poison. This no-milk treatment is not by any means a new idea. It has been taught for some years by a few of the best authorities; but it has not been sufficiently insisted upon. Moreover, the reason for it has not been hitherto understood. It was believed in somewhat of a vague way that the digestive organs lose their capability of digesting milk, and experience showed that the exclusion of milk led to improved results. But now that we know that a powerful poison is formed from the putrefaction of the milk, the necessity of its exclusion must become apparent to all. I reported last year a case which is so applicable here that I must be pardoned for quoting it in full. If the child had been an animal upon which I wished to experiment I could hardly have selected conditions more favorable:

"July 30, 1886, about one o'clock P. M., I was called to see the seven months' old babe of Mr. B. I found that the child had been vomiting quite constantly for some three hours. It had also passed watery stools some six or seven times. The eyes were sunken, skin cold and clammy, and pulse rapid and small. I diagnosed cholera infantum. During the preceding night the child had seemed as well as usual, and had taken nourishment freely from the mother's breast. Early in the morning it had been given a bottle of cow's milk, and soon thereafter the nausea and vomiting began. Later, as stated above, the child began to purge. The mother, furnishing an insufficient supply of milk, it had been the habit to give the child cow's milk several times through the day. I prohibited the further use of milk, both that from the mother and from the bottle, and substituted meat preparations and rice-water as foods. I also prescribed pepsin, bismuth subnitrate, chalk mixture, and camphorated tincture of opium.

"The cow's milk which had been furnished the child was from an animal kept by one of the neighbors. On the evening of the same day that the child was taken sick I obtained two quarts of the morning's milk of this animal. The milk had the appearance of very rich cream, being of a yellow tint throughout. This milk was allowed to stand through the night of the 30th in the ice-box of a refrigerator. On the morning of the 31st I began the analysis. After pouring the milk from the pitcher there remained in that vessel about two ounces of a fluid the color of port wine. Microscopical examination of this fluid showed the presence of pus and blood corpuscles. The blood was also detected by obtaining the characteristic bands of oxyhæmoglobine with the spectroscope. The milk, which had already coagulated,

was filtered. The strongly acid filtrate was rendered feebly alkaline with potassium hydrate and then agitated with absolute ether. After separation the ether was removed with a pipette and allowed to evaporate spontaneously. This residue was dissolved in distilled water and again agitated with ether. This ethereal solution left, after spontaneous evaporation, a residue which had a slightly brownish tint. I did not obtain the crystals of tyrotoxicon, doubtless owing to this trace of impurity; but the residue had the color and taste of tyrotoxicon. This residue dissolved in some distilled water and given to a cat produced retching and vomiting.

"That tyrotoxicon was present in the milk taken by the child shortly before the beginning of its illness there could now be no doubt. It is true that the milk was abnormal in other respects, also, inasmuch as it contained pus and blood.

"After the withdrawal of all milk and the use of the medicinal agents mentioned above, the child began to improve, and by the afternoon of August 1 it seemed so well that it was allowed a bottle of good cow's milk (from another animal); but soon after taking this milk it again began to vomit and purge. Milk was again withheld and the same medicinal treatment resorted to. This attack was slight, and after it the child continued to improve until the night of August 4, when the grandmother, 'who knew more about raising babies than the doctor did,' fed the child bountifully upon milk. Again the vomiting and purging began, and it was more than a week before all symptoms of gastro-intestinal irritation had disappeared. About the 15th of August milk was again allowed, at first in small quantity, and this seeming to have no harmful effect, more liberal quantities were given. The child has continued well since."

That my experience in this is not unique will be made evident by the following quotation from a recent paper by Dr. L. Emmet Holt, physician to the New York Infant Asylum, who writes as follows: "In children under two years of age not fed at the breast, it is better to withhold milk entirely. This has been a subject of careful investigation during the past summer at the New York Infant Asylum, and both the resident physicians and myself have had this proved to our satisfaction by a large number of cases. Peptonized milk is very much less likely to disagree than either condensed milk or fresh cow's milk. But in many, even this caused an aggravation in the intestinal symptoms, particularly in severe and protracted cases. Again and again have I seen relapses brought on when milk was added to the diet in cases where the stools had been practically normal for two or three days."

The food used may consist of chicken and mutton broths, beef juice, and rice or barley water. With this list, no difficulty will be experienced in giving the child sufficient nourishment. In the medicinal treatment the first thing to do is to cleanse the alimentary tract as thoroughly as possible. In the first stages of the disease there is no better agent for this purpose than castor oil. But if there have already been several serous discharges, copious enemata of water will be more suitable. These injections may contain either an astringent or a germicide, or both. For the latter, Holt recommends benzoate or salicylate of sodium, and for the former nitrate of silver or tannic acid.

The next thing to be done is to arrest the growth of the germ. This germ has been found so far to develop only in acid media. Therefore, I think it wise to administer some antacid. Probably there is nothing better in this

line than the old chalk mixture. In the preparation of the chalk mixture, the druggist should be requested to use glycerine, as many druggists still use syrup in this preparation. The presence of the sugar leads to rapid decomposition during hot weather. It has been said that the use of the antacid is irrational, because the discharges are often alkaline. Of course, the serous discharges are often alkaline, because they consist of blood serum, and will be alkaline unless they have remained in the intestine long enough to ferment; but the reaction of such discharges does not prove that the contents of the stomach and small intestine are alkaline.

As to the use of germicides, much is yet doubtless to be learned. No doubt the chief effect of subnitrate of bismuth in this disease may be due to its effect upon the germ. Holt makes an excellent showing for the salicylate of sodium, but since he has been using this drug, he has followed the no-milk diet, and doubtless his lessened mortality has been due to the exclusion of milk quite as much as to the salicylate. He uses this drug in doses of from one to three grains every two hours.

I am now making some experiments with the object of ascertaining the effect of certain germicides on the development of this poison. The results, I will give in some future paper, but I may state here what my success has been in a few experiments with mercuric chloride. The method of conducting the experiments was as follows: Four ounce bottles were filled with milk, milk and ferment, and milk and ferment with mercuric chloride, closed with glass stoppers and kept in an air bath at the temperature of the body for six hours. Then the milk was tested for tyrotoxicon with the following results :

No. 1. Bottle containing pure milk only. Result, no poison.

No. 2. Bottle containing pure milk only. Result, no poison.

No. 3. Bottle containing milk and ferment. Result, the poison present.

No. 4. Bottle containing milk and ferment. Result, the poison present.

No. 5. Bottle containing milk, ferment, and one-hundredth grain mercuric chloride. Result, poison present.

No. 6. Bottle containing milk, ferment, and one-fiftieth grain mercuric chloride. Result, poison present.

INTERNATIONAL MEDICAL CONGRESS.

REPORT OF PUBLIC-HEALTH WORK AT MEETING IN WASHINGTON, D C., SEPT. 5-10, 1887.

BY ARTHUR HAZLEWOOD, M. D., MEMBER OE THE MICHIGAN STATE BOARD OF HEALTH.

To the Michigan State Board of Health:

GENTLEMEN:—In accordance with the expressed wish of this board, I attended the meeting of the Ninth International Medical Congress, at Washington, D. C., Sept. 5 to 10 inclusive. Promptly at 11 o'clock A. M., Sept. 5, the large auditorium of Albaugh's opera house being filled to repletion, the lower floor by members alone, the galleries by members accompanied with ladies, the meeting was called to order by Dr. Henry H. Smith, chairman of the executive committee. After relating some facts concerning the reason of the assemblage, he introduced the President of the United States, who, in a very few words, declared the congress open for "organization and business." Then followed the reading of the names of the officers of the congress, the installation of Dr. N. S. Davis as President, reports, etc.,—the references to the friction aroused in the earlier work of committees being felicitiously expressed. The address of welcome was made by the Hon. Thomas F. Bayard, Secretary of State, in a very happy vein which was highly applauded. Brief speeches followed in different languages.

Next in order came the address of Dr. N. S. Davis, President, of the Congress, in his usual masterly manner, very little traces of his age and physical infirmities being discernable. He opened with a fitting tribute to the late and lamented Prof Austin Flint, and largely extolled the work of climatologists in the profession, and urged continuous action in the observations recording prevailing diseases and meteorological conditions.

The work of the congress was facilitated by division into eighteen sections. Although a printed programme was published, it was found necessary to issue for each section a daily bulletin. It was impossible to attend all that would interest one; limiting the selection to but a few of the many sections, I endeavored to fill my time with such subjects as come more particularly in the work of our Board, therefore, I can make but a very imperfect report.

Dr. Chas. Warrington Earle, in section devoted to Diseases of Children, read a paper entitled, "An investigation to determine whether the absence of sewerage and of water pollution diminishes the prevalance and severity of diphtheria." The conclusions arrived at from observations and correspondence with physicians located in different sections, were: That no one

cause is invariably accepted as the cause of diphtheria, although English practitioners, particularly, believe in sewer gas; that the disease occurs in all localities, well sewered and without sewers, among the affluent and the poor, in cities and in remotely isolated dwellings; that unsanitary surroundings, damp cellars, filthy outhouses, etc., are not the cause of the disease, but by their presence lessen the resisting power of the occupants of such premises, and thus often aid the disease to assume a more severe type; that the disease is communicable, and often carried long distances by infected persons, clothing and railroad cars; that it is eminently desirable that legal means should be available to compel people to take precautions preventing the spread of the disease.

Some remarks followed citing proof of the correctness of the conclusions. Dr. Vaughan finished the discussion by stating that diphtheria is not a filth disease, but induced by a specific poison, and that disinfection is the proper means for its restriction.

Dr. J. A. S. Grant (Bey) read a history of the sanitary service in Egypt in which he severely criticised the British government for its claim that cholera was endemic in that country, he citing statistics to prove the contrary.

Dr. Charles Denison of Denver, Col., presented a paper on the "Comparative Importance of Different Climatic Attributes in the Arrest of Phthisis," in which he claims that cold air can be inspired in greater quantity than warm because of density, thus bringing a relatively larger percentage of oxygen into the system. That mountainous regions have purer air, and that the purity and density from coldness of such regions permits of greater expansion of the chest and lungs, with good results in cases of phthisis not too far gone.

Unfortunately, I failed by attendance on this address to be in time to listen to the entire translation of Dr. Domingos Freire's paper on Vaccination in Yellow Fever. During the discussion the Doctor was asked several questions to which he gave answers interpreted by one of the secretaries,—among others that the attenuation of the virus is produced by exposure to the air, and by successive inoculations failing to find suitable soil for its propagation in the virulent form. That the microbe of yellow fever is of a vegetable nature and measures the one-thousandth of a millimetre.

Resolutions were adopted calling upon the different nationalities represented to appropriate funds and assign investigators to conduct experiment relative to this subject.

The question was asked whether the microbe of yellow fever could be distinguished from that of the malarial fever microbe, which was answered in the affirmative.

Subsequently to the session I asked a gentleman, who had spoken affirmatively to Dr. Freire's claims, what the experience had been of the inoculated cases as to permanency of effect, to which he answered that no answer was possible beyond the fact that the longest period since the introduction of the method was two years and that such inoculated persons had not as yet contracted the disease.

Dr. Seaton of London detailed the proceedings of the sanitary authorities in dealing with contagious diseases in that city, in which he explained the confusion arising from the fact that the large district we ordinarily know as London is not one corporation, but a community of different districts, but in the main the result does not differ widely from our own. Medical officers

are responsible, medical attendants must notify authorities of the presence of contagious diseases and are paid a small fee therefor.

At the present time the isolation hospitals in the city and near are used for diseases such as scarlet fever, measles, typhus, etc., whilst small-pox is removed a long distance down the river to some floating hospitals. In the vicinity of the isolation hospitals are houses furnished, in which families or individuals exposed to contagious diseases may be domiciled until incubation stage is over. Disinfection is the chief reliance in prevention of contagious diseases, and vaccination in small-pox. The small-pox hospitals are located at Tory Reach, 15 miles down the river. The reason given for the present location was, that, when the disease was treated in populous centers, the infection was carried long distances by the atmosphere, and many abuses had occurred, such as the employment of unvaccinated nurses, or the mingling of nurses with unprotected persons. Finally he stated, that the cases giving the most trouble were those severe ones which it is unjustifiable to remove to a hospital. In answer to a question it would appear that our British cousins are not all infallible in making returns of communicable diseases. It was stated that Dr. Burdon Sanderson had suggested as one means of preventing communicable diseases the building of hospitals capable of consuming the expired air, and that Detroit, Mich. possessed such a hospital.

Prof. Albert Leeds, of New Jersey, read a paper on the nutrition of infants, having a diagram in colors, representing the different constituents of mothers' milk, and, in contrast, analyses of different kinds of infants' foods, also showing the difference in quantity of certain constituents of cow's milk as compared with woman's, claiming that the latter is more highly organized and contains 13½ per cent of solids. It was emphasized that starch cannot be digested by young infants, and that cane sugar is prejudicial to them. He denounced all the forms of infant foods and claimed the only substitute for mothers' milk for infants, to be cows' milk, diluted with an equal quantity of water, to which cream must be added and milk sugar, and treated with trypsin to digest the albuminoid sufficiently to bring them into the more highly organized condition found in woman's milk.

Dr. Taylor, U. S. army, refutes the ideas of Condelli and others of the non effect of drinking water from shallow wells, streams, etc., in causing malarious affections, citing in proof the experience of troops stationed at different military points, where in several instances after the cessation of the use of surface water, malarious diseases also ceased to prevail.

I listened with pleasure to some portion of Dr. G. F. Blandford's address in the general session on the treatment of recent cases of insanity in asylums and private homes, the general purport of which was, that kindness, comfort, and freedom from restraint and irritations should be the rules of treatment, that asylums should always be extra mural, and in many cases should be on the cottage plan, that best results would most generally attend treatment in proper asylums.

Dr. A. W. Leighton's paper on the place of sanitary science in education, was a plea for teaching the subject in the public schools and by such adjunct methods, lectures, etc., as were feasible in the different neighborhoods.

On several different occasions I attended the sessions in other sections where many things of interest were to be heard, but not bearing on sanitary science, I will omit their recital. Respectfully submitted,

A. HAZLEWOOD.

INTERNATIONAL MEDICAL CONGRESS, MEETING IN WASHINGTON, D. C., SEPT. 5-10, 1888.

REPORT OF ATTENDANCE BY PROF. VICTOR C. VAUGHAN, M. D., MEMBER OF THE MICHIGAN STATE BOARD OF HEALTH.

To the Michigan State Board of Health:

In the place of Dr. H. F. Lyster, one of your regularly appointed delegates, I attended the session of the ninth International Medical Congress held in Washington, D. C., Sept. 5 to 10, 1887. There was much work of sanitary value done in the various sections. The paper of the President of the section on climatology and demography was regarded as one of special value in the valuable suggestions made concerning the methods of study necessary to investigate the effects of climate on health. Dr. Baker of this Board presented to the same section an instructive paper upon the influence of climate on diseases of the lungs, and another on the same subject was given by Dr. Dennison of Colorado. The paper of Dr. Chas. Smart before the same section was one of marked value. Dr. Morse K. Taylor gave a very valuable paper before the section on hygiene, in which he showed that malarial diseases had prevailed to the greatest extent among troops supplied with poor water, and that these diseases had decreased greatly at these places on the introduction of good water, notwithstanding the fact that the other conditions of life remained unchanged. Before the same section Dr. Grant (Bey) gave an interesting paper on the sanitary work being done in Egypt. Many other papers of value were heard, but the mere mention of them would render this report too long.

One half day was spent in visiting the army medical museum and library which was just being transferred to the elegant and commodious building recently constructed. Under the able management of Dr. Billings the library now ranks as the best medical library in the world. Some time was also spent in the Bureau of Animal Industry and in the chemical laboratory of the Department of Agriculture. Drs. Salmon and Smith in the former and Dr. Wiley and his assistants in the latter are doing sanitary work of great value, for the exact nature of which you are referred to their official reports.

Respectfully,

V. C. VAUGHAN.

NATIONAL CONFERENCE OF STATE BOARDS OF HEALTH.

FOURTH MEETING, IN WASHINGTON, D.C., SEPT. 7, 1887.

REPORT OF ATTENDANCE BY HENRY B. BAKER, M D.

To the President and Members of the Michigan State Board of Health:

GENTLEMEN :—As a committee of this Board, I attended the conference of State Boards of Health in Washington, D.C., Sept. 7 and 8, 1887. Most of the States were represented, also the Province of Ontario, the president and secretary of that Board being present. The meetings were profitable, the work being mainly the statements of the various methods employed by the State Boards in the different States for the advancement of the public health. Prominent among the topics discussed were those sent in by this Board as follows :

1. Does your State Board receive, from every part of its State, prompt notification of the occurrence of diphtheria, scarlet fever, typhoid fever, and small-pox ?

2. If such notification is received, does your State Board send an expert to each locality where a case occurs ?

3. Just what is done by each State Board of Health on receiving a notice of diphtheria, scarlet fever, typhoid fever, or small-pox ?

These questions were responded to by representatives from many States, each delegate being allowed eight minutes.

Dr J. T. Reeve, of Wisconsin, said :—

1. " Wisconsin has an organization such as is necessary to secure the notification of contagious disease in the manner contemplated in this question. Under our laws a local Board of Health must be organized in every town, village, and city in the State; all physicians must report to the local Boards, which have jurisdiction of the places in which such diseases exist, all cases of three of the diseases named in this inquiry, namely: Diptheria, Small-pox, and Scarlet Fever; and the local Boards must in their turn report to the State Board. Typhoid Fever is not specifically mentioned in the law as one of the diseases to be reported, but the State Board of Health has power to add to the list any disease that it may by resolution declare to be dangerous and contagious.

" Our machinery for obtaining reports is therefore good, and practically, I believe, we are notified of the occurrence of these diseases in a large proportion of instances. A question that we frequently ask of local Health Boards is whether physicians are prompt in giving notice of the appearance of

such diseases as the law requires, and the answer to this question is generally such as to make us feel that good, and progressively good—though in many cases far from perfect—work is being done in this direction.

2. "With reference to sending experts to localities where such diseases exist, it would, as a rule' be wholly impracticable so to do, often unnecessary, and probably often unwise. When, however, circumstances have seemed to require it, the secretary, or some member of the Board, has visited the infected locality and, with the local authorities, has investigated the causes of the origin or continuance of the disease, and has advised as to the proper or practicable means for its control or arrest. We believe it wise to work as much as possible by means of the local Boards of Health.

3. "On receiving such notices they are first systematically recorded in our books, after which their receipt is courteously acknowledged, with thanks for promptness and completeness, where such thanks are due, with effort to secure promptness and completeness in future reports where there has been manifest delay in the one respect or lack in the other, and with special letters of advice or encouragement to the local Board where this seems necessary or desirable. In all cases we supply the local Board liberally with circulars for general distribution, treating of the nature and management of the particular disease that may be prevalent at the time in the locality, and we endeavor also to utilize the local press by securing the republication of such circulars through its means. Finally and chiefly, taking advantage of the prevalence of disease in any locality and using it as a text, we endeavor to educate both the local Boards of Health and the public in matters of general and special sanitation, and to create and build up that public sentiment in favor of the enactment and enforcement of sanitary laws, without which the simple existence of such laws upon the statute books has and can have no value whatever."

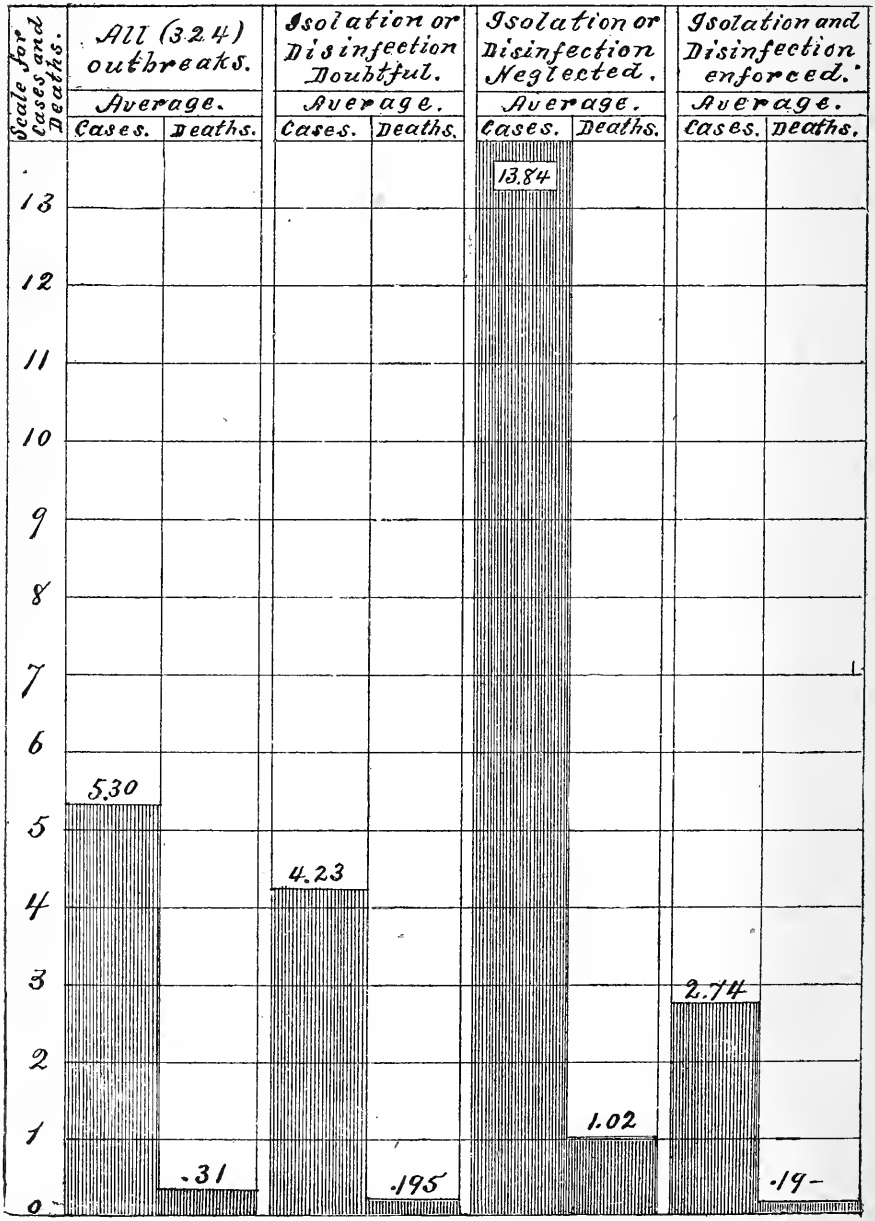
My own response for Michigan was as follows:—

(1.) As a rule the Michigan Board does receive from every part of the State prompt notice of the occurrence of small-pox, scarlet fever and diphtheria, and reports of the occurrence of typhoid fever are beginning to be generally received; the proportion of such occurrences reported is somewhat in proportion to the time during which the State Board has been laboring to educate the people relative to each disease; next to small-pox the first disease brought to the notice of the citizens of Michigan was scarlet fever, and it is now generally known in Michigan that this is a disease dangerous to the public health and must be reported; next, diphtheria was taken up, and more recently typhoid fever.

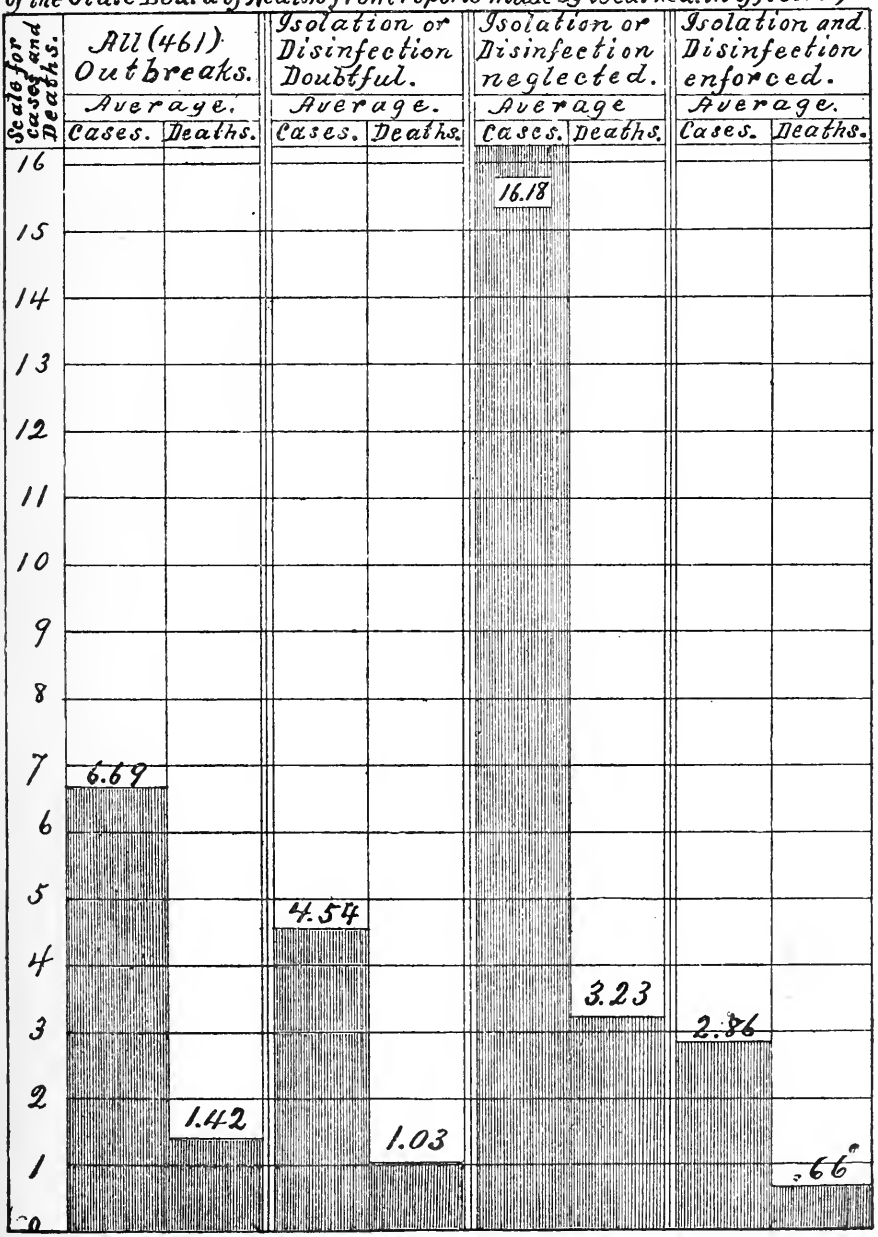
(2.) The Michigan Board does not generally send an expert to a locality where a dangerous disease occurs. [This subject was dwelt upon in my paper on the "New Means of Prevention," etc.]

(3.) On receiving notice of a case of diphtheria, scarlet fever, typhoid fever or small-pox the information is at once recorded in a book specially prepared for each of these diseases, showing at a glance several facts which aid in obtaining further information and in compiling the data at the close of the year. Pamphlets containing concise instructions how to restrict that particular disease are immediately sent to the Health Officer with a request that he distribute to the *neighbors* of the families in which the sickness is, because it is believed that they will be most likely to read them at such times and to guard their own families from the danger. The idea of danger *from* neighbors is then readily accepted, and the idea of danger *to* neighbors is afterwards in some cases more easily accepted than if that idea were first presented. The Health Officer is urged to stamp out the disease; to isolate, disinfect, and report weekly the status; and after the disease is over a final report is required stating the number of cases, number of deaths, kind and amount of disinfectants used, and other methods employed. At the office of the State Board all such information is tabulated and published in the annual report of the Board. An effort is made to utilize such information as soon and thoroughly as possible. For instance, I show you a diagram which exhibits at a glance on a single page the results of the action of the health authorities throughout the State, during the year 1886, relative to the spread of diphtheria. It shows that in the 461 outbreaks the average number of cases was 6.69 and the deaths 1.42 to each outbreak; that in the 116 outbreaks in which isolation and disinfection were enforced the averages were: Cases, 2.86; deaths, .66, while in the 102 outbreaks in which either isolation or disinfection was neglected the cases and the deaths were about five times as many, namely: Cases, 16.18; deaths, 3.23. A similar diagram shows the results of action to restrict scarlet fever. The differences, however, are not so great as in diphtheria. One of these leaflets, giving the combined expression of all the health officers relative to a given disease, is sent to a Health Officer who reports the presence of one of these diseases, and can not fail, I think, to supply stimulus for more effective efforts for isolation and disinfection.

Scarlet fever in Michigan in 1886: The Average Numbers of Cases and Deaths per outbreak:-1, in all the 324 outbreaks reported; 2, in the 221 outbreaks in which it is doubtful whether or not Disinfection or Isolation were secured; 3, in the 45 outbreaks in which Isolation or Disinfection or both were neglected; and 4, in the 58 outbreaks in which Isolation and Disinfection were both enforced. (Compiled in the office of the Secretary of the State Board of Health from reports made by local health officers.)



Diphtheria in Michigan in 1886, exhibiting the Average Numbers of Cases and Deaths per outbreak:- (1) in All the 461 outbreaks Reported, (2) in the 243 outbreaks in which it is Doubtful whether or not Disinfection or Isolation were secured, (3) in the 102 outbreaks in which Isolation or Disinfection or both were neglected, and (4) in the 116 outbreaks in which Isolation and Disinfection were both enforced. (Compiled in the office of the Secretary of the State Board of Health from reports made by local health officers.)



After all delegates had responded, my paper on the "New Means of Restricting Dangerous Communicable Diseases" was read. An extract from it is as follows:

TABLE I.—*Number of Places in Michigan at which Communicable Diseases were Reported Present During Each Week in 1886.*

Week ending		Diphtheria	Scarlet Fever.	Typhoid Fever.	Measles.	Small-pox.
January	9	26	9	2	1	0
	16	28	18	3	3	0
	23	25	25	3	5	0
	30	23	18	6	4	0
February	6	28	22	4	7	0
	13	23	31	5	5	0
	20	28	24	4	3	0
	27	17	16	3	3	0
March	6	17	22	5	3	0
	13	13	17	5	1	0
	20	16	16	6	4	0
	27	15	14	3	7	0
April	3	16	14	5	4	0
	10	18	15	3	6	0
	17	18	12	1	3	0
	24	18	13	1	5	0
May	1	17	15	2	5	0
	8	21	11	4	9	0
	15	18	14	3	9	0
	22	20	15	4	9	0
	29	23	22	2	8	0
June	5	22	24	2	6	1
	12	13	16	2	8	2
	19	19	15	1	5	1
	26	14	14	4	6	2
July	3	11	12	2	3	2
	10	16	13	6	1	2
	17	12	9	6	4	2
	24	19	9	8	5	2
	31	16	10	9	6	2
August	7	14	13	11	5	2
	14	23	11	14	7	2
	21	15	12	16	5	2
	28	20	12	21	5	2
September	4	21	9	17	8	3
	11	23	11	21	5	1
	18	28	12	24	6	1
	25	28	12	19	7	1
October	2	27	12	23	3	1
	9	26	16	20	3	1
	16	26	20	19	5	1
	23	42	18	20	3	1
	30	36	21	15	4	1
November	6	25	20	18	6	1
	13	33	17	23	9	1
	20	32	19	19	4	1
	27	34	21	11	4	1
December	4	41	23	15	6	1
	11	30	14	11	6	1
	18	24	15	11	6	1
	25	29	21	10	4	0
1887. January	1	23	13	6	10	0
Total		1,170	827	478	269	42
Average per week		22½	15 47-52	9 5-26	5 9-52	21-26

Taking the sum of the averages in Table I, as representing the total number of places in which communicable diseases were reported each week, we have a total of fifty-four places per week, at which one or more of the diseases were reported present. This shows too many places, however, as

at Detroit and a few other places two of these diseases are present nearly all of the time, and a Health Officer is acting, more or less, all the time.

Selecting a few weeks as typical of the different seasons of the year, I have prepared the Table II, to show the number of *different* places at which the diseases were reported present, counting each locality but once. Thus the places at which scarlet fever, typhoid fever, measles and small-pox are reported are each additional to and distinct from those reporting diphtheria or any other communicable disease.

TABLE II.—*Average Number of Places where Communicable Diseases were Reported in 1886.*

Weeks ending	Diphtheria.	Scarlet Fever.	Typhoid Fever	Measles.	Small-pox.	Total.
January 16	28	13 additional.	1 additional.	1 additional.	0 additional.	43
June 19	19	11 "	0 "	2 "	1 "	33
October 16	26	14 "	16 "	1 "	0 "	57
December 18	24	9 "	6 "	2 "	0 "	41
Totals	97	47 additional.	23 additional.	6 additional.	1 additional.	174
Averages	24¼	11¾ "	5¾ "	1½ "	¼ "	43½

Table II shows an average for each week of forty-three separate and distinct places at which one or more of these communicable diseases were reported present; and this number, forty-three, divided by the number of places which an expert could in each week visit and perform his service, will indicate the number of experts which would have been required for the proposed "distribution of men" in Michigan in 1886. The localities are somewhat widely scattered; but, perhaps an expert might visit and act at four places per week, in which case eleven men would thus be constantly employed. One question bearing upon Dr. Hewitt's proposition, is the expense; another question is one in Social Science, namely: Whether it is best for a central office to do the main work of combatting contagious diseases, or whether it is best that each locality should be trained to do this for itself. To this last question I have no hesitation in saying that, in my opinion, it is best to teach the localities to do this for themselves. But if the central office can afford the expense, it may be practicable, and if so, it seems to me it would be very useful to so far adopt Dr. Hewitt's suggestion as to have one expert, or more *sanitary inspectors*, constantly traveling from place to place to inspect the work of disinfection, etc., in the localities.

* * * * * * * *

You have probably noticed that the "New Means of Prevention" treated of in this paper is not altogether the distribution of documents which Dr. Hewitt thus characterized, but it is in great part the "distribution of men" suggested by Dr. Hewitt. Several of our State Boards of Health have distributed documents, and Michigan makes no claim that such distribution is now a new means of prevention; yet we do claim that statistics of sickness and deaths in Michigan in 1886, collected since the last meeting of this Conference, conclusively show that there was a large saving of life and health in Michigan in the year 1886 from scarlet fever, and especially from diphtheria, in certain localities where the directions contained in the pamphlets sent and distributed in these localities were carried into effect. This great saving of life and health was, we believe, in a considerable degree, due to the distribution of documents to the neighbors of persons sick as well as to the Health Officers. If, by means of statistics or otherwise, the "distribution of men" can be shown to promise better results, we should hail it as a great blessing to humanity.

INTER-STATE NOTIFICATION OF DANGEROUS COMMUNICABLE DISEASES.

The following resolutions were adopted by the National Conference of State and Provincial Boards of Health, at Toronto, October 6, 1886:—

(Also presented to and adopted by the American Public Health Association, October 8, 1886.)

WHEREAS, It is necessary for the protection and preservation of the public health that prompt information should be given of the existence of cholera, yellow fever and small-pox; be it

1. *Resolved*, That it is the sense of the National Conference of State Boards of Health, that it is the

duty of each State, Provincial and Local Board of Health in any locality in which said diseases may at any time occur, to furnish immediately information of the existence of such disease to Boards of Health of neighboring States and Provinces, and to the Local Board in such States as have no State Board.

2. *Resolved*, That upon rumor or report of the existence of pestilential disease, and positive definite information thereon not being obtainable from the proper health authorities, this Conference recommends that the health officials of one State shall be privileged and justified to go into another State for the purpose of investigating and establishing the truth or falsity of such reports.

3. *Resolved*, That wherever practicable, the investigations made under the preceding section shall be done with the co-operation of the State and local health authorities.

4. *Resolved*, That any case which presents symptoms seriously suspicious of any of the aforenamed diseases, shall be treated as suspicious, and reported as provided for in cases announced as actual.

5. *Resolved*, That any case respecting which reputable and experienced physicians disagree as to whether the disease is or is not pestilential, shall be reported as suspicious.

6. *Resolved*, That any case respecting which efforts are made to conceal its existence, full history and true nature, shall be deemed suspicious, and so acted upon.

7. *Resolved*, That in accordance with the provisions of the foregoing resolutions, the Boards of Health of the United States and Canada represented at this Conference do pledge themselves to an interchange of information as herein provided.

At the National Conference of State and Provincial Boards of Health, at Washington, D. C., September, 1887, the following resolutions were adopted:

Resolved, 1. That the Conference reaffirms the principles contained in the resolutions adopted by it at its meeting in Toronto in 1886.

2. That the communicable diseases hereinafter mentioned, prevalent in certain areas or which tend to spread along certain lines of travel, be reported to all State and Provincial Boards within said area or along said lines of communication.

3. That in the instance of small-pox, cholera, yellow fever and typhus, reports be at once forwarded, either by mail or telegraph, as the urgency of the case may demand; and further, that in the instance of diphtheria, scarlatina, typhoid fever, anthrax or glanders, weekly reports, when possible, be supplied, in which shall be indicated, as far as known, the places implicated and the degree of prevalence.

"The report having been read it was voted that the vote, on its adoption, be taken by States. The vote being so taken was unanimous in its favor by all the States and Provinces represented by delegates present."

Dr. Fisher of Rhode Island, chairman of a committee, read a report relative to a plan for obtaining from physicians facts for the use of State Boards of Health.

On the topic, "What are the best methods for securing sanitary legislation," discussion was opened by Dr. Rauch, of Illinois, and participated in by Drs. McCormack, of Kentucky, and Baker, of Michigan.

A minority only of the committee on constitution and by-laws for the conference was present, and reported in favor of no change from the original form, and its report was adopted.

The committee to report the health laws of the States and provinces, was given further time, as was also the committee on vital statistics.

It is expected that, aided by the Secretary of the Conference, the Ohio Board of Health will publish a complete report of the proceedings of the Conference, and, that while it is yet in type, other boards of health may have reprints made for such uses as will promote the cause of public health in their own States. For this reason, this report has been made only a brief outline of the work. Respectfully submitted,

HENRY B. BAKER.

THE CAUSATION OF COLD-WEATHER DISEASES.

AN ATTEMPT TO EXPLAIN THE CAUSATION OF INFLAMMATIONS OF THE AIR-PASSAGES, AND THE SEASONAL SUSCEPTIBILITY TO CERTAIN COMMUNICABLE DISEASES WHICH ARE SHOWN TO BE MOST PREVALENT IN COLD WEATHER.

BY HENRY B. BAKER, M. D., SECRETARY OF THE STATE BOARD OF HEALTH, LANSING, MICH.

*Mr. President and Members of the Society**:

The facts which I have to present are mostly in the form of tables and diagrams; it follows, therefore, that what I read will be mostly theoretical considerations, designed to make the facts useful, but which remain for you to verify or reject. I trust that they may prove suggestive, and that their probable truth will be stronger near the close than near the beginning of this paper.

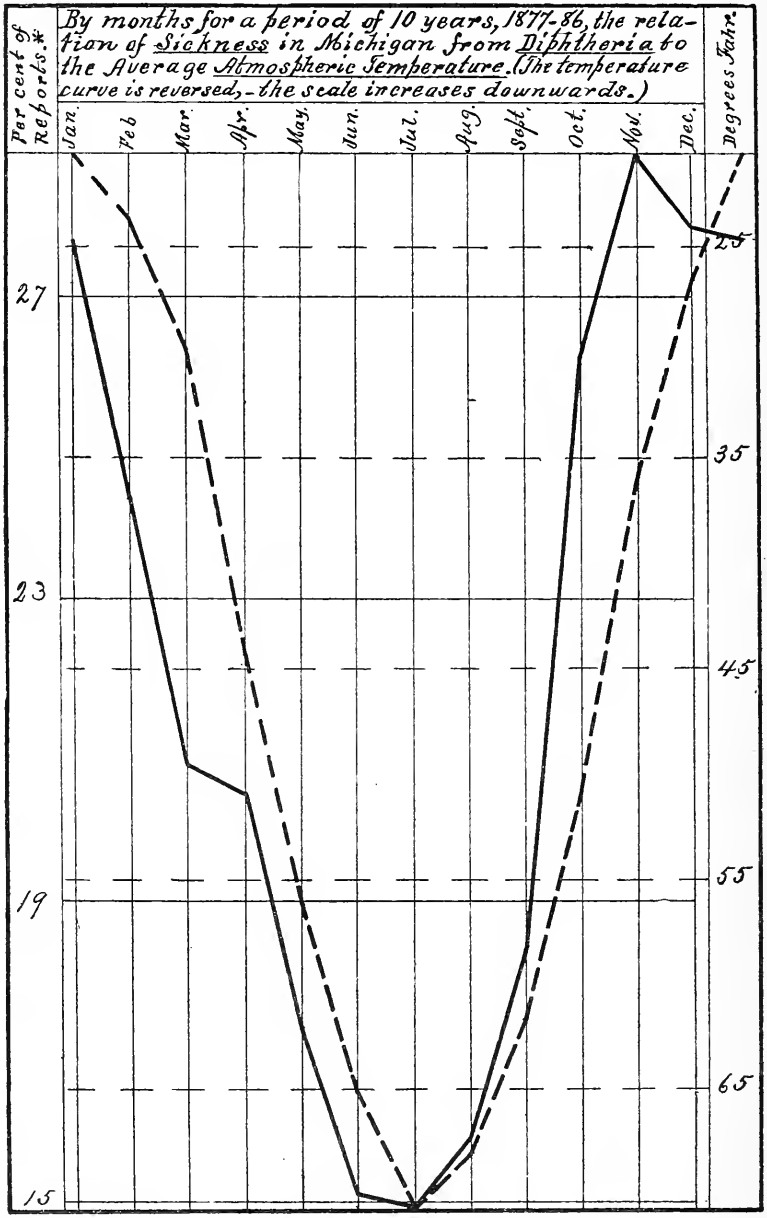
The fact that many of the communicable diseases are most prevalent at certain seasons of the year is well known; but the extent to which their prevalence is controlled by meteorological conditions, has not been thoroughly shown by statisticians. Herewith I present tables and diagrams exhibiting the close relations which diphtheria, small-pox and scarlet fever bear to atmospheric temperature.

TABLE 1.—By months for a period of 10 years, 1877-86, the relation which the sickness in Michigan from DIPHTHERIA sustained to the Average Atmospheric Temperature: Exhibiting the Average Atmospheric Temperature and what per cent all weekly reports received stated that diphtheria was under observation of the physicians who made the reports. (Over forty-one thousand weekly reports of sickness, and over 190,000 observations of the atmospheric temperature are represented in this table.)

	Jan.	Feb.	Mar	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average per cent. of reports, 10 years, 1877-86.....	27.7	24.3	20.8	20.4	17.3	15.1	14.9	15.8	18.4	26.2	28.9	27.9
Average Temperature, 10 years, 1877-86.....	20.56	23.62	29.80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.60

*The first part of this paper was prepared for and read at the meeting of the Michigan State Medical Society at Lansing, May 13, 1887, and although it has been re-written, it still contains traces of its origin which may call for this explanation.

1. Atmospheric Temperature, and Sickness from Diphtheria, in Michigan.

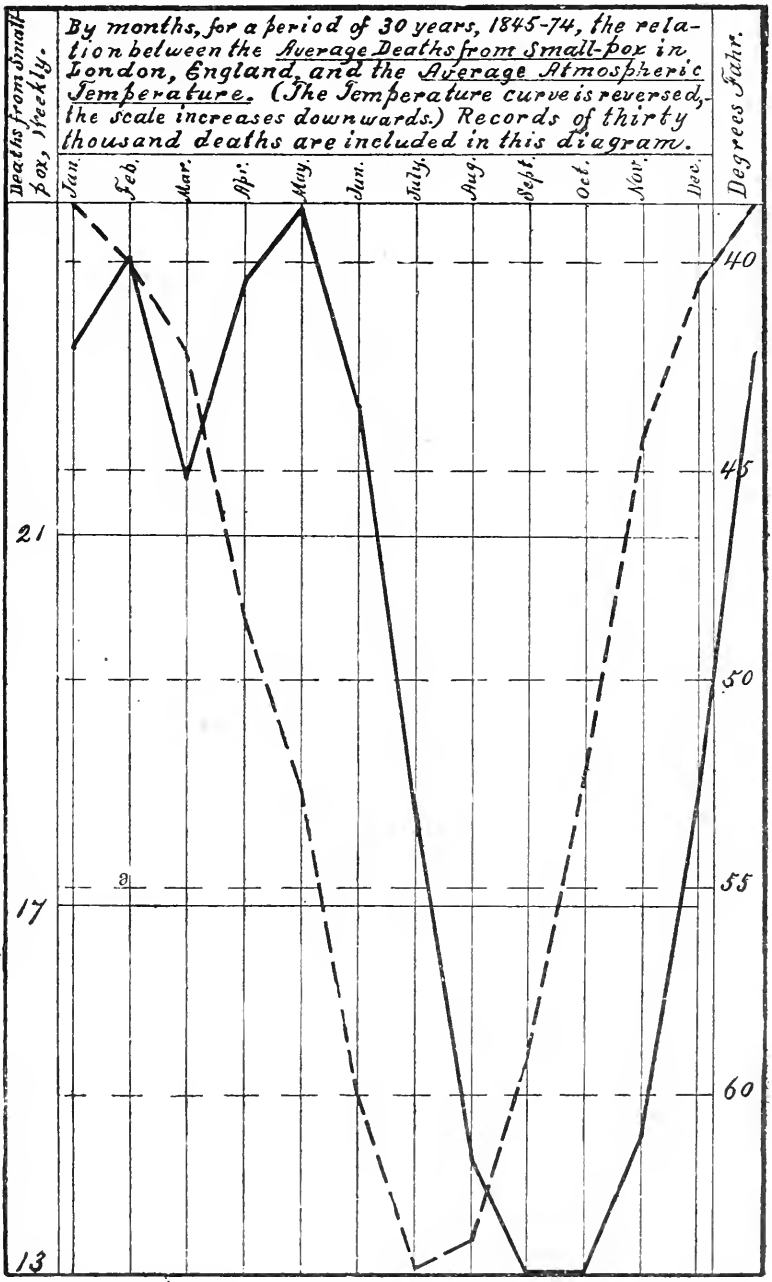


Diphtheria ———. Average Temperature — — —.

*Which stated that diphtheria was under the observation of the physicians who made reports.

Over forty-one thousand weekly reports of sickness, and over 190,000 observations of the atmospheric temperature are represented in this diagram.

2. *Atmospheric Temperature, and Deaths from Small-pox, in London, England.*

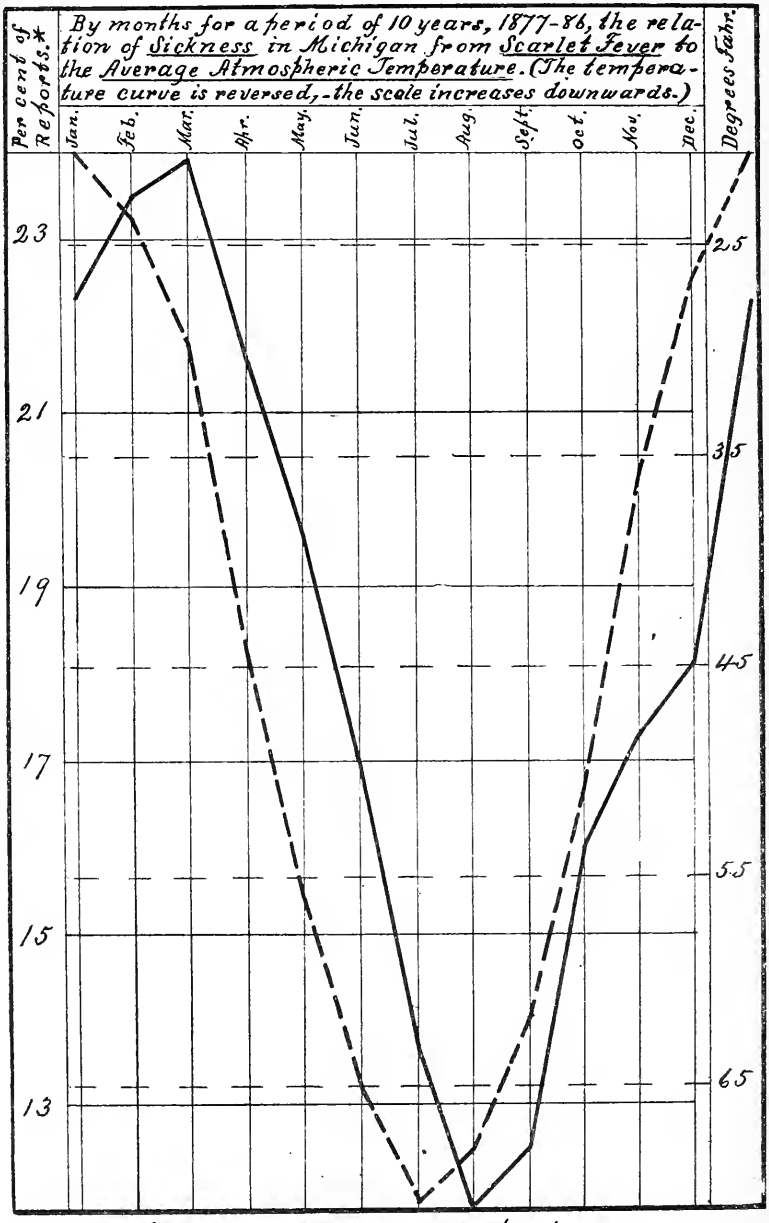


Small-pox ——— . *Average Temperature* — — —.

Except in a few months the Small-pox follows two months later than the temperature changes.

The line representing Small-pox should follow as long a time later than a line representing its controlling condition as is the average duration of the fatal cases plus the period of incubation?

3. Atmospheric Temperature, and Sickness from Scarlet Fever, in Michigan.



Scarlet Fever _____. Average Temperature — — — —.
*Which stated that Scarlet Fever was under the observation of the physicians who made reports.
Over forty-one thousand weekly reports of sickness and over 190,000 observations of the atmospheric Temperature are represented in this diagram.

TABLE 2.—By months, for 30 years, 1845-74, the relation between the Weekly Average Number of Deaths from SMALL-POX, and the Average Atmospheric Temperature, in London, England. Records of thirty thousand deaths are included in this table.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average weekly number of deaths, 30 years, 1845-74	23.00	24.00	21.60	23.75	24.50	22.40	18.00	14.25	13.00	13.00	14.50	18.20
Average Temperature, 30 years, 1845-74	38.6	40.1	42.2	48.6	52.7	60.0	64.2	63.5	59.1	52.2	44.2	40.5

TABLE 3.—By months for a period of 10 years, 1877-86, the relation which the sickness in Michigan from SCARLET FEVER sustained to the Average Atmospheric Temperature: Exhibiting the Average Atmospheric Temperature and what per cent of all weekly reports received stated that Scarlet Fever was under observation of the physicians who made the reports. (Over forty-one thousand weekly reports of sickness, and over 190,000 observations of the atmospheric temperature are represented in this table.)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average per cent of reports, 10 years, 1877-86	22.3	23.5	23.9	21.6	19.6	17.0	13.7	11.8	12.5	16.0	17.3	18.1
Average Temperature, 10 years, 1877-86	20 56	23.62	29.80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.60

DIPHTHERIA is most frequent in the autumn and winter, accompanying somewhat, in its rise and fall by seasons and by months, the fall and rise of the temperature, and the rise and fall of the velocity of the wind. In papers relating to pneumonia* I have shown that diseases of the air-passages (pneumonia and bronchitis) follow a similar law, and that this is probably due in great part to the influence of the salts of the blood, notably the chlorides, which accumulate in the mucous lining of the air-passages in undue quantity when the air inhaled is unusually cold and dry, and especially, as I believe, if the food eaten is unusually salt.

As in scurvy, purple spots sometimes occur on the legs, supposed to be due to an abnormal condition of the blood, brought about through the ingestion of salt foods, so in those diseases of the throat which occur during cold weather, I believe there are frequently to be seen in the mouth and fauces purple patches; and as in scurvy the purple spots sometimes ulcerate or slough over small areas, so it seems to me in the sore throats, ulceration or sloughing may occur. So, if these observations shall be verified, the causation of a throat disease in some respects resembling diphtheria, seems to be susceptible of explanation by supposing that through the abnormal displacement of salts necessary to health, or through the directly poisonous action of an excess of the chlorides (such as common salt), there occurs a death of the superficial tissue which is exposed to the constantly increasing quantity of salt, due to excessive evaporation of the natural moisture of the

*One of these papers was published in the annual report, Michigan State Board of Health, for 1886, pages 246-324.

parts. Malignant diphtheria is sometimes characterized by the death of a portion of the mucous membrane. But supposing a membranous slough, caused in the manner I have suggested; as soon as a slough has occurred, there is opportunity for the rapid reproduction of bacteria, which, during the life of the mucous membrane, were unable to gain ascendancy. Under such circumstances it seems probable that ordinary septic organisms, will multiply, and their poisonous products may be absorbed into the circulating blood. Is it not possible that a sore throat having the apparent characteristics of diphtheria, and followed by the phenomena of septicemia, may thus be caused (in a person whose blood is abnormally saline, and whose throat is tender), by the continued exposure to the inhalation of air unusually cold and dry, the constant evaporation of the fluids in the posterior nares and fauces, leaving behind a constantly increasing proportion of the salts of the blood, notably common salt, this salt permeating the mucous membrane, displacing other normal salts which should remain present, and these chlorides in excess acting as an irritant poison, capable, when sufficiently concentrated in the tissue, of causing the death of the tissue?

It seems probable that a false membrane may be formed by the exudation of fibrinous material in accordance with a law of osmosis, which is stated by Prof. John C. Dalton, as follows:

"But a substance like albumen, which will not pass out by exosmosis toward pure water, may traverse a membrane which is in contact with a solution of salt. This has been shown to be the case with the shell membrane of the fowl's egg, which, if immersed in a watery solution containing from 3 to 4 per cent of sodium chloride, will allow the escape of a small proportion of albumen. Furthermore, if a mixed solution of albumen and salt be placed in a dialysing apparatus, the salt alone will at first pass outward leaving the albumen; but after the exterior liquid has become perceptibly saline, the albumen also begins to pass in appreciable quantity." *

What determines whether an exudate shall be pultaceous, leathery, or croupous, I have no new evidence to offer. Neither have I new evidence on what causes or constitutes the contagious element. Evidence already on record seems to indicate that there are exudates which do not contain specific germs, or at least are not capable of communicating a serious disease, and that there are exudates which do contain specific germs, or at least are capable of communicating diptheria to persons *supposed* to be in health—that there is croup which is *not* diphtheritic, and that there is croup which *is* diphtheritic. The term diphtheria, however, is differently employed—by some being restricted to cases in which there is a false membrane, by some to cases in which there is sloughing of the real membrane, while by others it is made to include all cases which are communicable, irrespective of the character of the exudate or of the inflammation. I think this last is the view most conducive to the public health. And, since there is no certain way in any first case whereby a physician can always tell whether or not the case is one of those which tends to communicate diphtheria, there seems to be need for a plan of action, for the public safety, which shall recognize the difficulties which have been met with. A few years since the State Board of Health in this State passed preambles and resolutions which, although familiar to some of you, may be of interest and of utility in this connection. They are as follows:

*Dalton's Physiology, 6th Edition, Phila., 1875, p. 363.

Whereas—It is often difficult to recognize mild cases of diphtheria, or to distinguish such cases from a simple tonsilitis, pharyngitis or laryngitis, and

Whereas—Such mild cases of diphtheria often communicate a dangerous and fatal form of diphtheria;

Resolved—That it is the duty of physicians and householders in reporting diseases dangerous to the public health, and of local health authorities in their efforts to restrict such diseases, in every case to give to the public safety the benefit of the doubt;

Resolved—That suspected cases of dangerous diseases should be reported and precautionary measures should be taken.

SMALL-POX.—From the diagram I offer, page 199, it may be seen that the deaths from small-pox bear a quantitative relation to the atmospheric temperature, rising after the temperature falls, and falling after the temperature rises. Its changes follow about two months after the temperature changes, possibly a little less than two months (the unit of the time in my diagram being one month), but certainly more than a month and a half. As the period of incubation probably averages less than a half of a month, and the average duration of the fatal cases is probably less than a month, is it not probable that the effects of low temperature are cumulative, the greatest effect being only after exposure to the inhalation of cold air for a considerable period of time? It is conceivable that the increase of small-pox or the deaths from* small-pox in the cold weather may, in some manner, be due to a lowering of the temperature of the blood of the body; but in that case the effect would not be deferred as it is shown to be by the diagram, and it does not seem so reasonable as that it is due to influences on the susceptibility of the air-passages to the reception and entrance of the virus. The removal of water from the body by way of the lungs, in excessive quantity, tends toward increasing the salinity of the fluids which constantly moisten the air-passages and air-cells. According to Prof. Dalton (quoted previously) *albuminous* constituents of the blood should pass out from the blood-vessels to such a saline fluid whenever it contains about 4 per cent of sodium chloride (common salt).

If through the continuance of rapid evaporation from the air-passages the salts of the blood tend to collect in the air-cells and the air-passages, and if when this salt reaches 4 per cent of the moisture which is always present, the albuminous constituents tend to pass out into the air cells and air-passages, the exudations which there occur after exposure to cold seem to be explained; and at the same time it seems probable that a virus like that of small-pox—capable of reproduction in the serum of the blood, may in such an exudate find a *nidus* more favorable to its lodgement than on the mucous membrane in its more normal condition. It seems to me, then, that this is the explanation of the reason why small-pox is, at nearly every season of the year, quantitatively proportional to the temperature of the atmosphere; it is because the absolute humidity of the atmosphere is controlled by the temperature, and because, other things being equal, the warmer the atmosphere the moister it is, and the less tendency there is toward the exudation of plastic material in the air-passages; and the colder the atmosphere the drier it is, and the greater the tendency toward exudations and ulcerations in the air-passages.

The extent to which moisture is generally exhaled from the air-passages is appreciated by all of us, but it may not always be held in mind how much greater the quantity is in cold weather than in warm weather. This may be

*The increase of deaths is so marked and regular that I infer there is an increase in the cases. The evidence of epidemics seems to show the same.

appreciated by remembering that air saturated with vapor will contain at zero F. only half a grain of water, at 32 degrees two grains, at 70 degrees, eight grains, while at 98 degrees—which is about the temperature at which air is exhaled—it will contain 18.69 grains. While, therefore, each cubic foot of air inhaled at 70 degrees F. will, when exhaled, abstract about ten and one half grains of vapor of water, if inhaled at zero it will abstract about eighteen grains.

A difference of seven and a half grains of water per cubic foot of air inhaled, seems a small difference, yet allowing 18 respirations per minute of twenty cubic inches of air each, there are 300 cubic feet of air inhaled daily, and a difference of 1,250 grains of water per day. Supposing each thousand parts to contain 3 parts of chloride of sodium,* less than four grains of salt per day would be left by the evaporation. However there are other facts (as the absence of the chlorides from the urine during the onward progress of pneumonia, and other considerations connected with the laws of osmosis) which support the belief that such a movement of the chlorides once started tends to continue until all that are available have been thrown out into the exudate. Probably one reason why this is so is that, as stated by Prof. Dalton,† "As a general thing, if the liquids employed be water and a saline solution, endosmosis is more active, the more concentrated is the solution in the endosmometer; that is, a larger quantity of water will pass inward toward a dense solution than toward one which is dilute." * * *

"When an animal membrane, accordingly, is placed in contact with two different liquids, it absorbs one of them more abundantly than the other; and if that which is absorbed in the greatest quantity is also readily diffused into the liquid on the opposite side, a rapid endosmosis will take place in that direction, and a slow exosmosis in the other. Consequently the least absorbable fluid increases in volume by the constant admixture of that which is taken up more rapidly."‡ If through evaporation, the fluid in the air passages and in the lungs becomes a more "dense solution" than the blood plasma in the capillaries, and consequently, the "least absorbable fluid," the tendency is then toward continued exudation into the air-passages and air cells in the lungs.

It has recently been shown by B. J. Stokvis‖ that in fatal poisoning of dogs and rabbits by the chlorides of sodium and potassium a prominent pathological condition is "a never failing" œdema of the lungs. This seems to prove experimentally one point which I had worked out theoretically,§ and is in harmony with the paragraph next preceeding this.

Scarlet Fever.—By the diagram which I present to you, page 200, it may be seen that the sickness in Michigan from scarlet fever appears to follow the temperature, falling after the temperature rises in the spring, and rising after the temperature falls in the autumn, the sickness changes averaging about one month later than the temperature changes. The probable reason for this (delay in the sickness changes) seems to me to be that the average duration of the sickness, plus the period of incubation, is more than half a month, and as the unit of time employed in the diagram is one month, the changes in the sickness appear to follow one month later than the tempera-

* Page 47, Dalton's Physiology, 6th Edition, 1875.
† Human Physiology, p. 362, 6th Edition, Philadelphia, 1875.
‡ Page 363, Dalton's Physiology.
‖ Archiv für Experimentelle Pathologie und Pharmakologie, Band 21, 3d Heft.
§ Page 302, Report Michigan State Board of Health, 1886.

ture changes. If this is the correct explanation, it will appear from the diagram that the average duration of the disease is greatest in the winter months; at least the maximum sickness is shown to be in March—two months later than the lowest temperature, which would thus appear if the average duration of the sickness, plus the period of incubation, was more than one month and a half. But I have found that the curves for non-contagious diseases—influenza, tonsilitis and bronchitis—which also are controlled by the temperature, do not lag two months behind the temperature at any season of the year. Curves for these diseases usually follow about one month later than the temperature changes, as shown by diagrams Nos. 4, page 207, 5, page 208, and 6, page 209. It would seem as if the average duration of scarlet fever in winter was longer than that of bronchitis, or, what to me is more probable, that the susceptibility to scarlet fever is greatest a certain time *after* exposure to the inhalation of cold dry air. The explanation seems to me to be the same as I have already stated with reference to small-pox and diphtheria, namely, the plastic exudation, thrown out in the air-passages after inhalation of cold dry air, has resulted in an accumulation of a sufficient quantity of the non-volatile salts of the blood; and the ulcerations which I have supposed may occur as a consequence of long-continued inhalation of cold dry air.

GENERAL CONSIDERATIONS.

The facts which seem to prove that the rises and falls of diphtheria, small-pox, and scarlet fever are (directly or indirectly) almost absolutely controlled by the atmospheric temperature, have now been set forth, as also have some of the facts and considerations which seem to prove that such control is indirect by controlling the quantity of vapor of water inhaled.

The foregoing evidence is greatly strengthened if we add to it the facts concerning the relations of meteorological conditions to certain other diseases (of the throat and air-passages) not known to be contagious. Therefore, tables 4, 5, and 6, and the corresponding illustrative diagrams, exhibiting the rises and falls of the atmospheric temperature and of the three diseases—influenza, tonsilitis, and bronchitis, as shown by the meteorological and sickness statistics for 8, 9, and 10 years, collected by the Michigan State Board of Health are here given. The diagrams indicate that each one of these diseases is controlled by the temperature of the atmosphere.

TABLE 4.—*Atmospheric Temperature, and Sickness from Influenza in Michigan.*

	Year	Jan.	Feb.	Mar.	April	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent of weekly reports stating presence of influenza.....	40	55	61	59	52	38	28	20	21	29	33	41	48
Av. At. Temp. Deg. F.	46.11	20.56	23.62	29.80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.60

TABLE 5.—*Atmospheric Temperature, and Sickness from Tonsilitis in Michigan.*

	Year	Jan.	Feb.	Mar.	April	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent of weekly reports stating presence of tonsilitis....	49	55	62	61	53	47	42	33	32	37	45	55	60
Av. At. Temp. Deg. F.	45.39	19.91	21.77	28.82	43.04	55.98	64.79	69.78	66.25	61.11	50.68	35.56	25.82

TABLE 6.—*Atmospheric Temperature, and Sickness from Bronchitis in Michigan.*

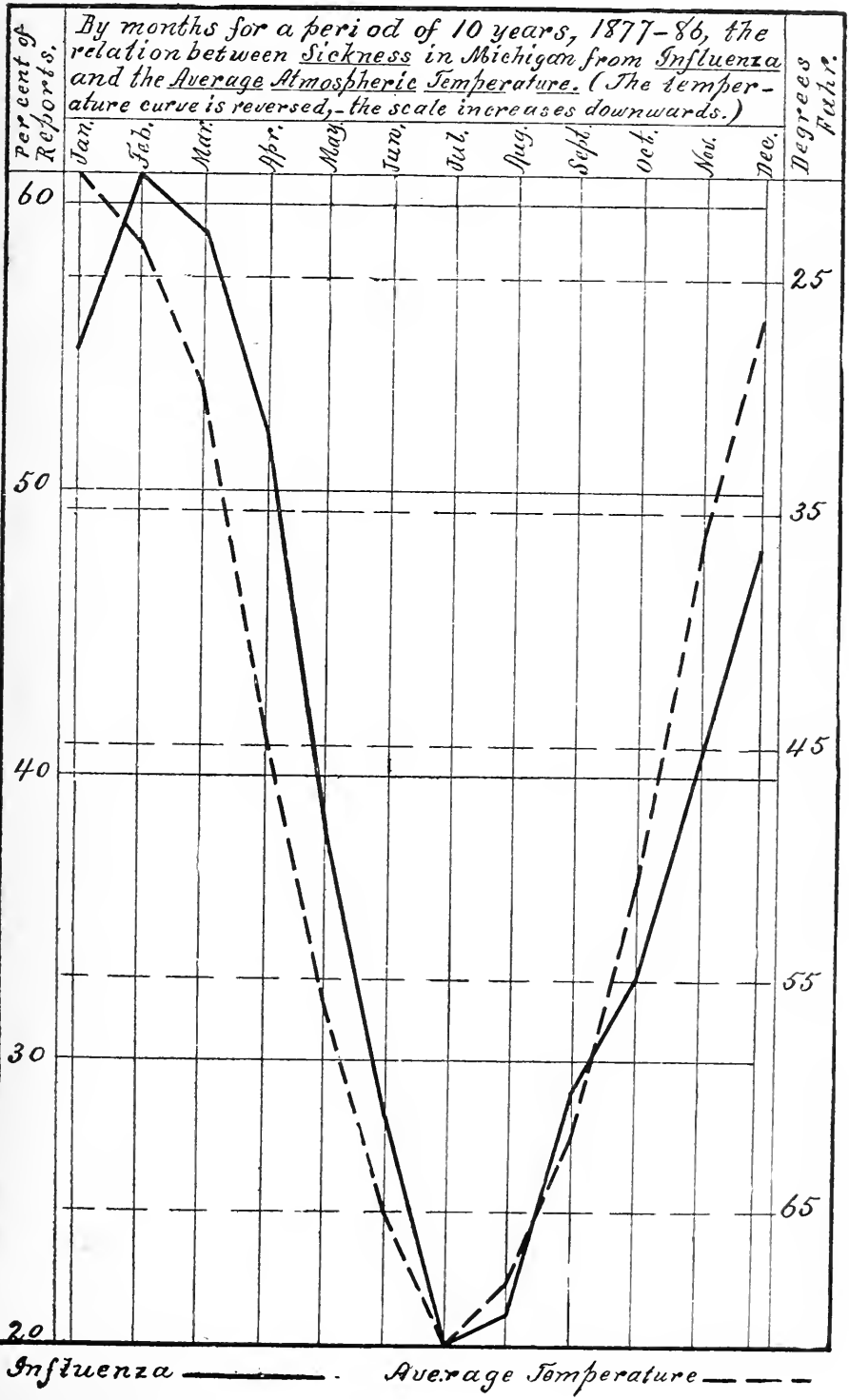
	Year	Jan.	Feb.	Mar.	April	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent of weekly reports stating presence of bronchitis....	62	77	78	77	72	61	54	43	41	49	55	67	72
Av. At. Temp. Deg. F.	46.25	20.77	28.89	29.76	44.14	56.23	65.30	70.73	63.23	61.73	50.72	36.23	27.28

Having learned that it is true that these diseases are so dependent upon the temperature of the air inhaled, the next question is *how* does the inhalation of cold air favor the causation of diseases of the throat and air-passages? In my opinion, the explanation has been given in this article, in connection with what has been said of the causation of diphtheria, small-pox, and scarlet fever. However, because these last-mentioned diseases are contagious, it does not necessarily follow that either influenza, tonsilitis, or bronchitis is contagious. Each of these diseases is an inflammation of the mucous membrane, brought about by some irritant which is either very generally distributed in the atmosphere, or very generally present in or upon the mucous membrane in the throat and air-passages. The irritant cause of each of these diseases is quantitatively proportioned to the temperature of the atmosphere. This is plainly indicated by the evidence herewith presented, as must be admitted by any one who will carefully examine the evidence, especially that in the diagrams. These inflammatory but non-contagious diseases are shown to be even more uniformly controlled by the atmospheric temperature than the contagious diseases are. The contagious diseases seem to follow these non-contagious inflammatory diseases of the throat and air-passages, and the reasons for this have, I think, been explained. I can think of no non-contagious irritant cause of each of these inflammatory diseases of the mucous membrane, more likely to be (as this cause is) quantitatively proportioned to the temperature of the atmosphere than is the non-volatiie salt deposited in and upon the mucous membrane in the throat and air-passages through the evaporation which constantly occurs so long as life, or at least respiration continues, and which, other things being equal, it seems plain must be deposited there in quantities proportioned to the absolute dryness of the atmosphere. As explained on a preceding page, in connection with the subject of small-pox, the absolute humidity of the atmosphere is controlled (as to its maximum at least) by the temperature. Cold air is always, necessarily, dry air.*

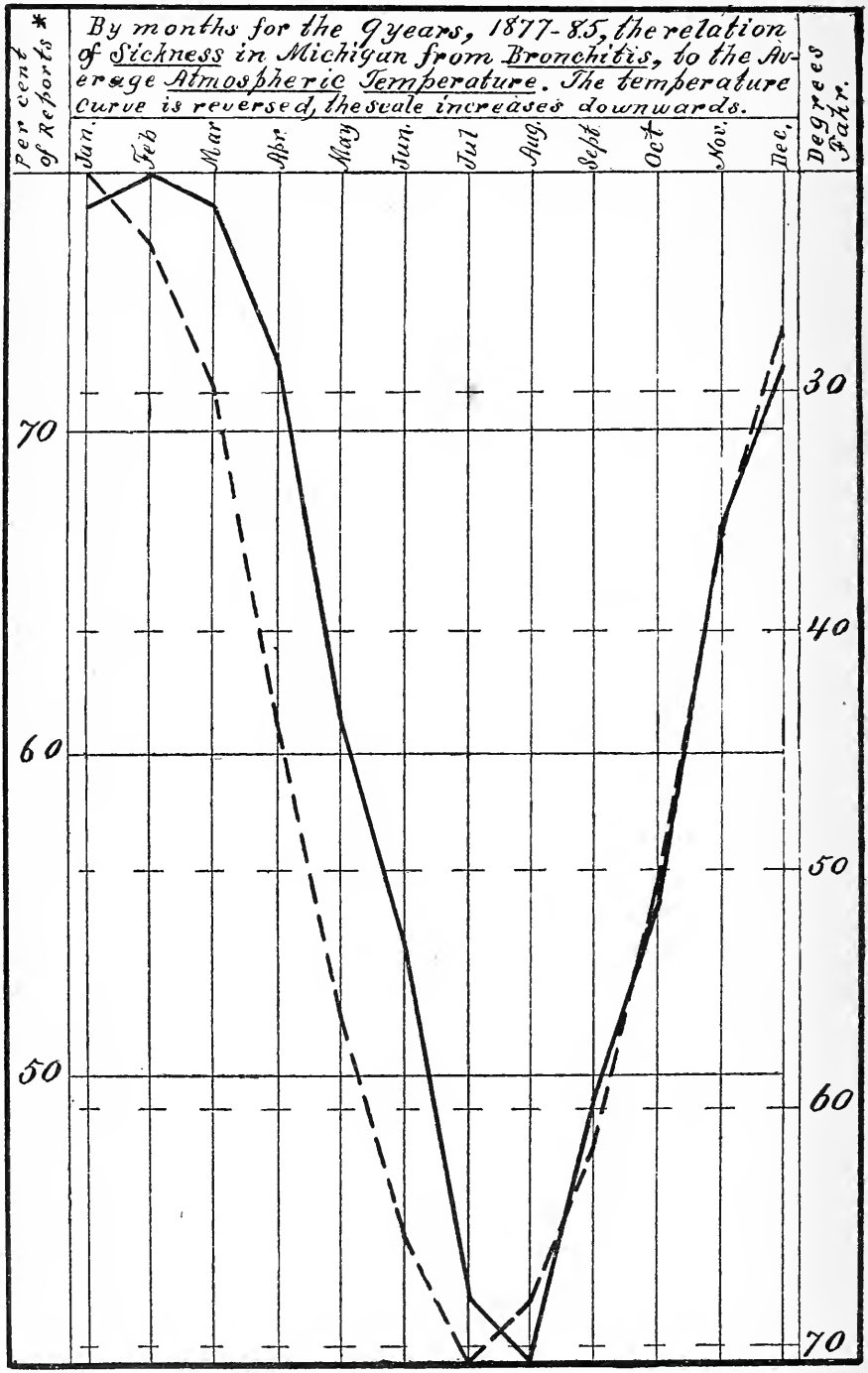
My belief is that the non-volatile salts—such as sodium chloride, potassium chloride, etc., (possibly including urea and uric acid) left in or upon the

* This statement is easily verified by consulting any good elementary work on meteorology.

4. Atmospheric Temperature, and Sickness from Influenza, in Michigan.



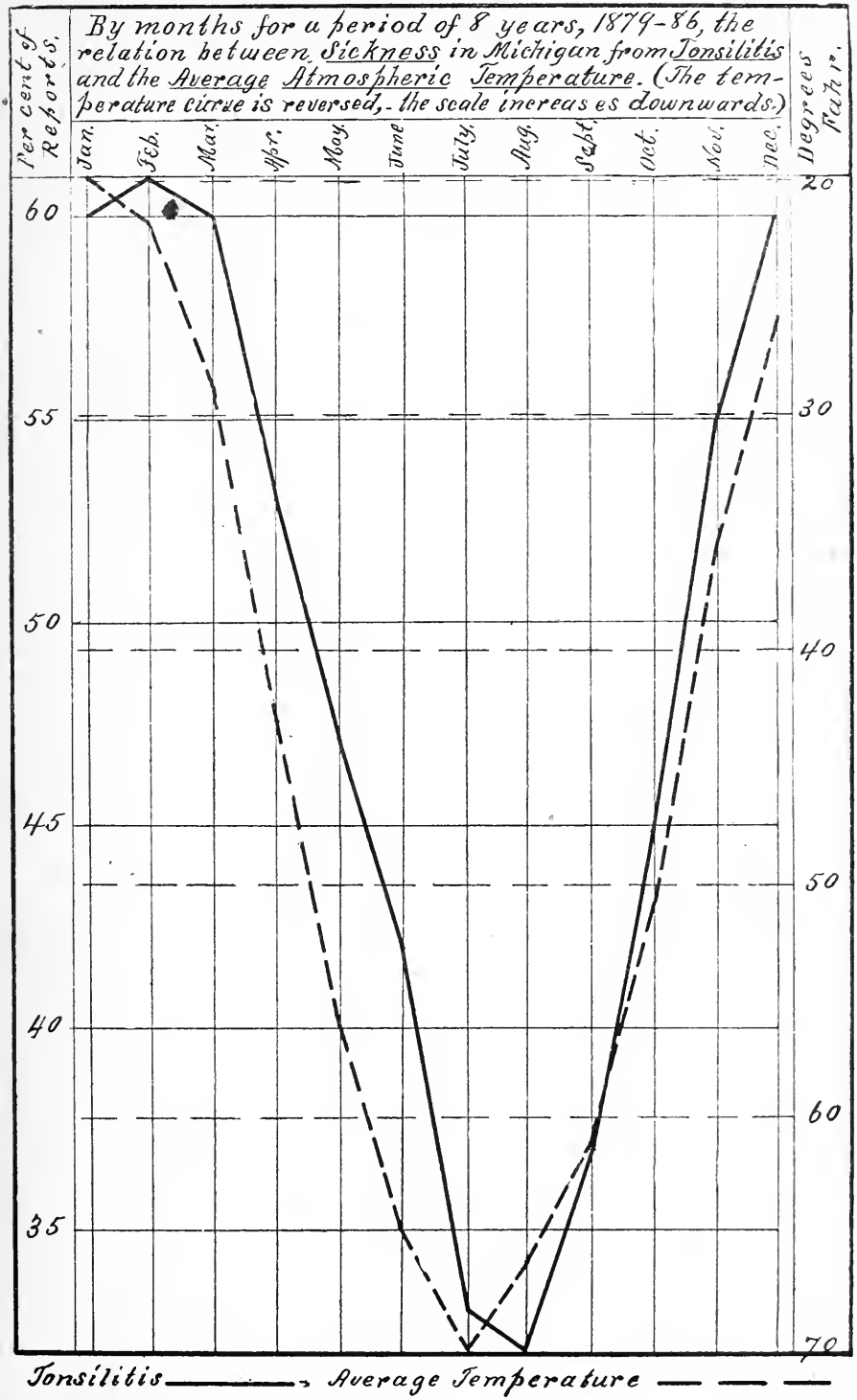
5. *Atmospheric Temperature, and Sickness from Tonsilitis, in Michigan.*



Bronchitis ———. Average Temperature — — —.

* Indicating what per cent of all reports received, stated the presence of Bronchitis then under the observation of the physicians reporting.

Over 35,000 weekly reports of sickness, and about 173,000 observations of the atmospheric temperature are represented in this diagram.


By months for a period of 8 years, 1879-86, the relation between Sickness in Michigan from Tonsilitis and the Average Atmospheric Temperature. (The temperature curve is reversed, - the scale increases downwards.)
Per cent of Reports.
Degrees Fahr.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
60
55
50
45
40
35
20
30
40
50
60
70
Tonsilitis
Average Temperature

mucous membrane in the air-passages in proportion to the quantity of vapor of water abstracted, are the irritant cause of the inflammations which we know as influenza, tonsilitis, bronchitis, etc., the name of the disease depending upon the portion of the mucous lining of the air-passages in which the irritation reaches the inflammatory stage.

This explains the reason why the non-contagious diseases of the air-passages are controlled by the temperature of the air inhaled.

A hint is supplied, also, as to what it is that makes some persons more susceptible than others to these diseases,—their food may be usually or frequently more saline, or their kidneys may not act so well (chloride of sodium is usually excreted by way of the kidneys). A similar explanation may apply to the greater susceptibility of the same person at one time than at another.

For several years, having in mind the fact that in vaccination it is considered essential to success that scarification shall be done to the surface in which the vaccine virus is placed, I have been accustomed to explain the greater prevalence during the cold weather of those contagious diseases which, like small-pox, enter the body by way of the air-passages, by the fact that the throat and air-passages were, during the cold weather, most likely to be irritated, "raw," and inflamed. But the fact that influenza, tonsilitis, and bronchitis—the inflammations of the throat and air-passages—do prevail most in and following cold weather, and that they are proportional to the temperature of the atmosphere has never been made so plain as by the statistics collected by the Michigan State Board of Health, and especially by diagrams 4, 5 and 6 illustrating this paper.

Even after the fact is established that these diseases are positively controlled in great part by meteorological conditions, complete yielding to that belief has still seemed to await the discovery and explanation of the reason why, and the exact way in which such inflammations are caused or favored by the inhalation of cold dry air. The cause which I have assigned, namely the presence of an excess of an irritating salt,* is, I believe, a "*vera causa*," a true cause, capable of causing inflammation if present and acting in or upon the mucous lining of the air-passages. That it is there "present and acting" is susceptible of proof by chemical analyses; the chlorides are alleged to be in excess in the exudate in croup; and experiments have proved that the chlorides which disappear from the urine during the onward progress of pneumonia† are found in the sputa and in the consolidated lung.‡

I trust, then, that I have pointed out:—

1. That diphtheria, scarlet fever, and small-pox increase after the atmosphere is cold and dry, and decrease after the atmosphere is warm and moist.

2. That the three communicable diseases named above probably generally enter the body through the air-passages, and that the reason why they increase after the cold months is because of the greater susceptibility of the air-passages in those months, and that this is the reason why the curves for these communicable diseases are found to follow the curves for influenza tonsilitis and bronchitis.

3. That the non-volatile salts of the blood exuded in excess into and upon

*Sodium chloride (common salt) may be taken as a type.
†Redtenbacher in 1850, and many observers since that time.
‡Lionel S. Beale, in 1852, Medico Chirurg. Trans., Vol. XXXV, London, Eng.

the mucous surfaces of the air passages are capable of leading to an inflammation which is called "influenza," "tonsilitis," or "bronchitis," according to the portion of the respiratory tract involved.

4. That, other things being equal, the non-volatile salts are left by evaporation on the mucous lining of the air-passages, in proportion to the dryness of the air inhaled.

5. That inasmuch as the absolute dryness of the air ordinarily depends upon its coldness, the inflammations of the air-passages should be expected to rise as they do after the cold dry weather, and fall after warm moist weather.

6. That the non-volatile salts are likely to be in excess in the blood under some conditions of diet or non-action of the skin or kidneys through which, under normal conditions, they pass out of the body. Therefore,

7. That certain kinds of diet, or non-action of the skin or kidneys, may predispose to inflammation of the air-passages, and consequently to any communicable disease, which enters the body by way of the air-passages, to which the person may be susceptible.

8. That, aside from the cause herein assigned (non-volatile salts), no other known cause, capable of causing inflammation of the air-passages, is "present and acting" in proportion to the coldness and dryness of the atmosphere.

In connection with the foregoing, a few supposed facts, not entirely outside of the province of this paper, should be held in mind, because they tend to modify the force of the evidence herein presented:—

a. Vaccine virus (and therefore, possibly the virus of the cold-weather communicable diseases) retains its vitality longer in cold than in warm weather.

b. The danger of contracting a communicable disease is probably increased by exposure to the contagium in a badly-ventilated room, and rooms are most frequently badly ventilated during the cold weather.

But neither of these two statements is known to be true so nearly in proportion to the temperature of the atmosphere as to explain the close correspondence with which the curves of these diseases follow the curves representing the temperature of the atmosphere. And since it is proved in this paper that the ordinary inflammations of the air-passages also follow the rises and falls of the atmospheric temperature, and are believed to be non-contagious, their equally close correspondence with the temperature changes cannot be accounted for by the varying degrees of vitality of a virus, nor by bad ventilation, especially as they are so frequently traced to exposure to cold outdoor atmosphere.

9. That so far as is yet proved by statistics of large numbers of cases, the strongest controlling cause of inflammatory diseases of the air-passages is exposure in a cold, dry atmosphere.

10. That, excepting inoculation and other similar exposure to the specific cause of the disease, the strongest controlling cause of the spread of those communicable diseases which generally enter the body through the air-passages is exposure in a cold, dry atmosphere.

HENRY B. BAKER.

INDEX.

ERRATA.

Page 21, 6th full paragraph, 4th and 7th lines,—for esther read ether.
Page 23, 5th full paragraph, last line,—for esther read ether.
Page 47, last foot note,—for page 49 read page 48.
Page 82, 4th line of table heading; for *according a to* read *according to a*.
Page 205, 11th line, for 208 read 209, and for 209 read 208.
Page 208, in heading over diagram,—for *5* read *6*, and for *Tonsilitis* read *Bronchitis*.
Page 209. in heading over diagram,—for *6* read *5*, and for *Bronchitis* read *Tonsilitis*.